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PHILADELPHIA MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

At the second meeting in Philadelphia, held last week, of the American Electrochemical Society, the same enthusiasm was manifest which characterized the meeting held there five years ago at which the society was organized. The attendance was large, but the programme of 31 professional papers was much too long for thorough consideration, and prevented proper discussion of some of the more timely subjects presented. While many of the papers were of a high order of merit, the greatest interest was shown in Dr. Edgar F. Smith's account of the admirable work done in electro-analysis under his direction at the University of Pennsylvania, and in the lecture by Dr. C. P. Steinmetz on electric conductivity in general and electric conduction through gases and vapors in particular. In view of the great success of the meeting, which indicates that the society is in most vigorous health and strength, much adverse comment has been occasioned by a proposition brought before the meeting which implied, in short, the inability of the society to continue to stand alone. The proposition was presented apparently in the interest of the American Chemical Society, and involved, first, the printing in one publication of all papers on physical chemistry and electrochemistry read before both societies; second, supervision of publication work by a joint board, and third, the merging of the *Journal of Physical Chemistry* in the proposed publication.

One of the principal advantages urged in favor of the proposition was that the members of the societies would get more for their money than at present, but apparently the psychological aspect of such an arrangement as proposed was not sufficiently considered. The only tangible evidence of the existence of the society is its *Transactions*, through which alone it possesses an individuality that under the proposed arrangement it would lose, and the society practically become merely an electrochemical section of the American Chemical Society. The American Electrochemical Society is in its membership far from being essentially a chemical body; on the contrary a large proportion of its most enthusiastic members have little interest in papers treating problems from the purely chemical standpoint, and it is very doubtful whether they would follow the society if thus diverted from the lines of development which have led it to its present prosperous condition. A step like that proposed would without doubt seriously impair the professional solidarity and the esprit de corps inspired in electrochemical workers by the foundation of the society, and we do not believe that the membership at large will feel that the attendant sacrifice of the interests of a rising profession and of a rapidly-expanding industry can be justified upon the mere score of economy or the supply of a larger quantity of reading matter for the same money.

Variable-Speed Three-Wire Motor.

A form of variable-speed motor which can be designated as "three-wire" on account of its resemblance to a three-wire generator, is described on page 943 of this issue by Prof. Benj. F. Bailey. Its operation at variable speed can most conveniently be appreciated by reviewing the variable e. m. f. characteristics of the so-called three-wire generator, which consists of a direct-current generator equipped with inductive reactance coils so connected as to produce at a point exterior to the armature a phantom of the neutral e. m. f. point of the armature. In its simplest form a single inductance is connected across an electrical diameter on the armature, the middle point of which forms the desired neutral e. m. f. point. The potential at this point is midway between that of the two outer leads at all positions of the armature when the load on the two sides of the system is balanced, but when there is an excess of load on one side of the system the e. m. f. of each side fluctuates through a certain range, the value of which depends upon the resistance and local leakage reactance of the inductance. The most convenient method for minimizing the fluctuation in the e. m. f. is to employ an additional inductance whose terminals are joined to the armature in electrical space quadrature to those of the other inductance, the middle points of the two being connected to the neutral wire of the system. It is evident also that any number of similar inductances could be added at various space positions, with a steadily decreasing added improvement in the elimination of the voltage fluctuation.

A well designed generator of this type with normal field strength will operate as a motor at normal speed when normal e. m. f. is impressed across the outer leads, or when an e. m. f. of one-half the normal value is impressed between one outer and the neutral; while its speed would be increased to double the normal value if the normal e. m. f. were impressed between the neutral and one outer wire. Intermediate speeds can be obtained by weakening the field when both outer wires are in use, while greater speeds are obtainable by weakening the field when one outer and the neutral wire form the circuits to the armature. The article referred to above describes several different schemes that may be used for interconnecting the "neutral" wire to the armature. It will be noted at once from reference to the article that the writer proposes the use of a single inductance coil inserted in series in the neutral wire circuit. A three-wire generator operated with the connections indicated would suffer an enormous and prohibitive change in the voltage between the neutral and each outer wire. A similar machine used as a motor would suffer a large change in the tendency to maintain constant speed; that is, its torque would fluctuate through a wide range, but during operation its speed would remain practically constant on account of the momentum of the armature. Thus the demand for constant driving torque in a motor is not so great as is the requirement for constant e. m. f. in a generator. With three isolated inductance coils connected between three points on the armature and the common neutral wire, the fluctuation in the torque may be lessened somewhat; it would be decreased to a greater extent if the coils were wound on a three-phase transformer core, while a much greater decrease would be obtained by the use of three inter-connected inductances. The author states that practically all of the current is confined to half of the armature. This statement is evidently intended to apply to certain instantaneous positions of the armature, and it should not be interpreted as indicating that certain sections of the armature are continuously devoid of current. An alternating current ammeter would doubtless show that each section on the armature between tapping points carries the same effective value of current as every other section and is subjected to the same heat loss. The current has no tendency to conduct itself in a selective manner with reference to armature sections that are symmetrically connected to the external circuit and pass through the same mechanical cycle during each revolution.

Commutating Poles in Direct-Current Machinery.

One of the most important developments in the constructive details of direct-current machinery within the past few years has been the use of commutating poles. An article in this issue gives an outline of the improvements rendered possible by the employment of such poles and points out the advantages and disadvantages occasioned by their presence. Not the least remarkable feature of this development is to be found in the fact that, although the excellent performance of machines of the commutating-pole type has been known for many years, the adoption of the auxiliary-pole construction did not become general until almost the present time. At this writing, however, almost every manufacturer of direct-current equipments uses commutating poles on some of his machines.

The slow progress made in the general application of this aid to commutation can, perhaps, be attributed to two prime causes, namely, the lack of conditions which rendered absolutely necessary the use of extraordinary precautions against sparking; and the former prevailing impression that only when the magnetomotive force of the armature is counterbalanced over the whole air-gap area could satisfactory results be obtained. The enormous demand that arose for variable-speed motors for direct connection to machine tools, and for high-speed generators for use with steam turbines, created conditions that could be met most satisfactorily by the employment of the commutating-pole construction. The requirements of commutation are fully met when the auxiliary pole furnishes flux solely in the coil directly under the brush, and the proper appreciation of this fact has caused manufacturers to adopt methods of winding the extra field coils with a minimum amount of copper and hence to produce satisfactory machines without unnecessary expense. There are extreme conditions, however, under which it may be desirable to resort to the more expensive construction embodying the complete neutralization of the armature magnetomotive force, as pointed out in the article in this issue.

It is interesting to note that auxiliary poles are being used with practically every type of direct-current commutator machine on the market at the present time, including constant potential and variable-voltage generators for high speed and low speed; constant-speed and variable-speed generators for low and high voltage; constant-speed and variable-speed shunt and compound-wound motors and series-wound motors for low and high voltage. The last few months have witnessed the introduction of the auxiliary-pole motor for railway work,

and many interesting developments are promised in connection with railway motors having high efficiency over a very large range of speed both for low and high voltages.

THE PROSPECTS OF INCREASED ELECTRIC RAILWAY VOLTAGE.

The electric trolley road has now been in practical service in this country for 20 years, reckoning from the initiation of the Richmond electric railway, and during all of that time there has been practically one trolley line e. m. f., namely 500 volts. It has not, of course, been rigidly adhered to, and motors are not nearly so sensitive to changes of line voltage as are incandescent lamps; the e. m. f. has been generally raised to 600 volts of late, especially on third-rail systems, and along country roads it has often fallen considerably below 500 volts with many cars operating simultaneously; nevertheless, the broad class of 500-volt trolley-line pressure has been remarkably well maintained for 20 years. The recent advent of the alternating-current series railway motor has caused the trolley line e. m. f. to be increased up to 3000 volts in some cases, 6000 volts in particular instances, principally abroad, and even to 11,000 volts under steam-railroad service conditions with private right of way. This great increase in line voltage, rendered possible by the use of alternating-current motors, makes the practicable distance between power houses, or sub-stations, very much greater than when the line e. m. f. is limited to 600 volts.

The conditions of service in cities and small towns, however, prevent the use of high-voltage wires in city streets. Moreover, within the limits of the ordinary town, the trolley e. m. f. of 600 volts is found to be adequate and satisfactory. The difficulties with this pressure are met in the open country on interurban routes. Here it is frequently necessary to transmit energy by high-tension alternating currents to distant sub-stations and to step-down the e. m. f. to 600 volts through transformers and rotary converters. It has recently been proposed to increase the direct-current trolley e. m. f. to 1200 volts, changing the generator and motor voltages accordingly. This would quadruple the distance to which a given number of cars could be operated from the power station without the intervention of high-tension alternating currents. In many cases it would enable sub-stations to be dispensed with entirely along interurban routes. If it should be found undesirable to operate at an e. m. f. of 1200 volts, in city streets, it might be practicable to operate 1200-volt motors at half-speed in the city limits and to operate at the full pressure and full speed beyond those limits.

The street-railway motor was for many years prevented from rising above 600 volts in pressure owing to difficulties in commutation under heavy load. With heavy load, any serious sparking at the commutator was liable to carry around, and short-circuit the armature. In recent years, however, the use of the auxiliary poles has enabled good commutation to be secured even at marked overloads, so that the commutating poles have enabled the e. m. f. to be increased to 1200 volts. It would not be surprising, therefore, to find the 11,000-volt alternating-current railway system come into use on long distance electrified steam railroads with private right of way, 6000-volt alternating-current long distance interurban railroad systems with 600-volt direct-current service in city limits, and 1200-volt direct-current trolley systems for ordinary interurban routes; that is, for systems where 3000 volts or more is not necessary in order to overcome the distance. Nevertheless, we may expect to find 600 volts the standard trolley pressure in cities for many years to come.

THE TEMPERATURE AND BRILLIANCY OF CARBON, OSMIUM AND TUNGSTEN INCANDESCENT FILAMENTS.

As noted this week in the Digest, an article has recently appeared in the *Electrotechnik und Maschinenbau*, by Herr A. Grau, on certain experimental studies of the luminous radiation from incandescent filaments. The results obtained go far to explain the relative luminous behavior of carbon and tungsten filaments. Ordinary carbon filaments consume about 3 watts per mean horizontal hefner (3.41 watts per m. h. c. p.). The standard U. S. central-station lamp consumption is somewhat less, or 2.86 watts per mean horizontal hefner (3.25 watts per m. h. c. p.). Of course, it is possible to make such lamps consume initially from 2 to 6 watts per m. h. c. p. The lower the consumption, the greater are the temperature and the efficiency, but the useful life time is rapidly diminished by the evaporation of the filament, and the deposit of the evaporated and condensed carbon on the walls of the lamp chamber. The consumption of three watts per hefner is, therefore, such as corresponds to the highest working temperature that can be safely employed in practice, consistent with a satisfactory duration of lamp life. The new tungsten lamps are expected eventually to consume one watt per mean horizontal hefner (1.135 watts per m. h. c. p.). By comparing the glowing filament of a 1-watt-per-hefner tungsten lamp with that of a 3-watt-per-hefner carbon lamp, it is manifest that the tungsten filament is the brighter, and, therefore, the hotter of the two. At this higher temperature, the average working life time is claimed to be of satisfactory length. The question is, therefore, is the reduced consumption and increased efficiency of the tungsten lamp due entirely to the increase of working temperature; or is it partly due to a difference in the quality of radiation, whereby there is emitted more visible and less invisible radiation?

The measurements of Herr Grau indicate that the temperature of a carbon filament consuming 3 watts per mean horizontal hefner is 1660° C. = 1933° absolute, and that of a tungsten filament, consuming 1 watt per mean horizontal hefner, is 1850° C. = 2123° Ab. The ratio of increase in absolute temperature is 1.1, or an increase of 10 per cent. According to the empirical law of Lummer and Kurlbaum, the light emitted by a glowing body increases as the 12th power of the absolute temperature, for temperatures over 1900° Ab. The twelfth power of 1.1 is a little over 3; so that if a carbon lamp were worked at a temperature of 2123° Ab., it would give about 3 times as much light as at its actual working temperature of 1933° Ab., which means that according to the Lummer and Kurlbaum law, it would consume 1 watt instead of 3 watts per hefner. Consequently, the increase of working temperature which the tungsten filament will stand without undue evaporation, is capable of accounting for all of the reduction in consumption. Moreover, it is interesting and instructive to observe that no differences in color or distribution of radiation were found between filaments of osmium and tungsten; so that assuming this to be the fact, all the improvement of tungsten over osmium filaments is attributable to the more refractory qualities of the former, or to the higher temperatures they will withstand.

Electric Patent Pooling Arrangement Upheld.

When the patent agreement was entered into between the General Electric and Westinghouse companies 10 years ago, the Sherman Act was already in force and there were being enacted anti-trust laws in various States, which it was thought could be interpreted to prevent the General Electric and Westinghouse companies coming to a positive agreement to regulate prices upon their products as protected by their respective patents.

A decision has recently been rendered by the United States Circuit Court of Appeals for the Seventh District which deals with this question in a way to protect the owners of patents and inventions. The following extracts from this decision are pertinent:

"——— is the owner of a valid patent. That stands as an unquestionable fact on this writ of error. The only grant to the patentee was the right to exclude others, to have and to hold for himself and his assigns a monopoly, not a right limited or conditioned according to the sentiment of judges, but an absolute monopoly constitutionally conferred by the sovereign lawmakers. Over and above an absolute monopoly created by law, how can there be a further and an unlawful monopoly in the same thing. Is a greater injury or deprivation inflicted, if plaintiff authorizes a combination or pool to do what plaintiff can do directly? To say yes means that substance is disregarded, that scare words confer upon the people some sort of a right or interest counter to the monopoly, when by the terms of the bargain the people agreed to claim none until ———'s (the patentee's) deed to them shall have matured.

"None of the provisions of the contract, in our judgment, touched any matter outside of the monopoly under the patent. The control of prices and output, for reasons already stated, did not deprive the public of any right. Both before and after the period covered by the contract the market was demoralized, prices were cut, and the owner of the patent was getting nothing except by the slow and expensive process of litigation; but the public was not entitled to profit by competition among infringers. The internal agreements relating to royalties, proportioning the business, supervision and penalties did not affect or concern the public at all. ———, the owner of the patent, had the right, either alone or through licensees, to accumulate funds with which to push the ——— tire on the market and in so doing to undersell the makers of other tires and infringing makers of the ——— tires. The public is not injured by an arrangement to compete with adversaries for the public's patronage.

"Now, were the patentee the manufacturer, he would unquestionably have had the right to fix and maintain his own prices; and were the other parties to the contract manufacturers for the patentee, at a given figure for such manufacture, the patentee's right to fix and maintain the selling price would still remain; nor could this be questioned were he to make the manufacturers his selling agents also. How, then, does the contract under review make a case in which the patentee through his manufacturer is not entitled to fix and maintain prices—how is the arrangement, in effect, different in any way of restraining trade or competition, from the arrangement just supposed, in which the patentee unquestionably has that right?

"True, in the case under review, the manufacturers *as to the public*, are not competitors; but neither would they be in the cases supposed; in both cases the public suffering nothing except what the patentee had the right to exact; for so long, at least, as the patentee is not exacting, as the value of his invention, an unreasonable sum (and his action in that respect is not here questioned) it is within his own right to say whether the price exacted should be retained by himself, or shall be distributed among the people manufacturing for him. The contracts, therefore, in the case before us, having been made in good faith, and not as a mere subterfuge, I can see in them nothing that the Sherman Act was intended to prevent."

"Stanley Rule" Transformer Patent Litigation.

The Unied States Circuit Court of Appeals for the Second Circuit of New York, in a decision rendered last week, sustained on appeal patent No. 469,809 granted to the Westinghouse Electric & Manufacturing Company as assignee of William Stanley, Jr., on March 1, 1892. This patent, which is claimed to cover fundamentally the transformer, has been the subject of considerable litigation, in one instance not having been sustained and in several other instances declared valid. The present opinion was written by Judge Townsend.

The principal point in the litigation turned on the interpretation of the claims of the patent in the light of a so-called "C^2R rule" given in the specifications. The claims of the patent in suit relate to "a primary coil containing such length of wire exposed to magneto-electric induction that when operated with the dynamo with which it is to be used with its secondary circuit open, the electrical pressure and counter-pressure in its primary circuit shall be equal with incandescent lamps or other translating devices in the secondary circuits. "Each converter adapted to the dynamo operating the system has its primary coil made of such length that when supplied with its full proportionate share of the entire normal e. m. f. of the machine, its secondary circuit being open, the electrical pressure and counter-pressure in the primary shall be approximately equal with the translating devices in the secondary circuits of the converter to be cut out of the circuit when not in use without the introduction of any resistance in the place of them."

The "Stanley Rule" as given in the specifications and which figures so largely in the litigation is as follows: "The first thing to be determined is the length of the primary coil. This should be of such length that reacting self-inductively upon its own magnetic circuit the average counter potential so produced approximately equals the potential applied to the primary circuit. When so constructed an ammeter will practically show no current when the secondary circuit is open. To obtain these results in practice I use the following method: I first choose the percentage of efficiency to be obtained. Then having selected a type of magnetic circuit affording as great magnetic conductivity as possible, I apply such a length of primary conductor that acting self-inductively upon its core, the difference of the counter potential and applied potential multiplied by the current in the converter shall equal the predetermined loss of energy inevitable in conversion, and vary the length of wire until the desired results are obtained."

The court held that it may consider as determined by the prior decisions in its circuit that as Stanley was the first to discover and suggest that the difficulties encountered in attempting to secure self-regulation were due to an improper length of wire in the primary coil, and to disclose a method of means for determining the proper length of wire, thereby proportioning the energy absorbed by the generator to the energy consumed, he was entitled to cover broadly any transformer having substantially such length, irrespective of the method by which such length was ascertained. The question of infringement thus depends on whether the primary of the defendant's transformer has substantially such a length of wire as would have been obtained if its length had been determined by the Stanley C^2R rule. The court states that while it now appears that by the use of later appliances other losses of which the patentee was ignorant, may be measured and ascertained, it does not understand that this ignorance of the patentee or the knowledge subsequently gained from the prior use affects the status of the invention in suit. The fact that the patentee did not fully understand the principle upon which his invention operated or that his instructions were capable of a construction which would render the patent impracticable and defeat his purposes, should not deprive him of the benefit of a meritorious invention, provided it appears, as it is found in this case, that the patent sufficiently disclosed to those skilled in the art the cause of

previous defects and a new and useful discovery and invention, by means of which they might be successfully overcome. He is not to be deprived of the benefits of his invention because he may have been mistaken in his statement of the reasons why the result was secured or may have failed to correctly state the theory of their operation. When Stanley instructed the constructor to wind on wire until the loss of energy was provided for, he must necessarily have referred to that loss which was capable of being ascertained by measurement. Neither the patentee nor the public at the date of the invention could have estimated losses other than the copper losses on the open primary.

Accident to Mr. Bion J. Arnold.

As we go to press a newspaper despatch reports a shocking accident to Mr. Bion J. Arnold. The report states that while Mr. Arnold was making some adjustment of the machinery of the automobile of his brother, the engine "kicked back," striking his chin, which brought his teeth together and the end of his tongue was entirely severed. The account continues: "Mr. Arnold closed his mouth firmly, though the blood from the severed tongue drenched his clothes, sprang into the machine and drove rapidly and accurately to the Mercy Hospital, where he arrived twenty minutes after the accident happened. The surgeons stitched the tongue together and assured Mr. Arnold that it would knit and that he would in time be able to speak again." Another account states that in the hospital Mr. Arnold with pencil and scratch pad gave this explanation of how the accident happened: "Was with my brother in his new auto. He killed the engine, I got out to crank it. Spark lever was too far advanced. Engine kicked back and pulled my chin down on radiator. It cut my tongue clean off. I drove machine to Mercy Hospital, where Dr. J. M. Lilly sewed it on. I am doing no talking for several days."

Electric Power in Factories.

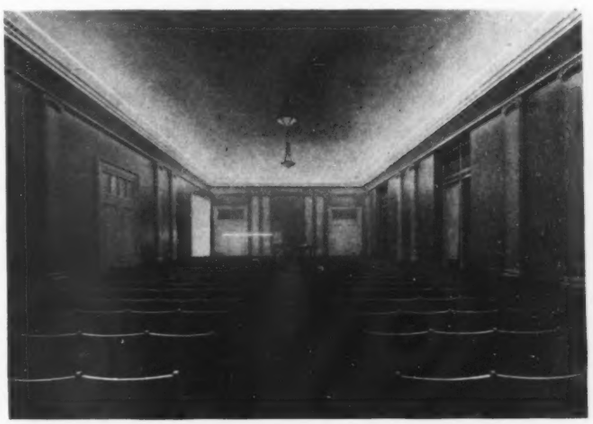
In a paper on the subject of "Electric Power in Factories," read at the May meeting of the Cleveland Electric Club, Mr. F. Houghton compared the losses between electric drive and transmission by shafting. The friction at the bearings in shaft transmission is very high. At one steamship dock in New York City it was estimated that it took three tons of coal per day to run the shafting alone. Such losses are practically eliminated by the use of electric power.

The great flexibility of electric transmission allows hoists to be installed to advantage in many situations where it is difficult or inexpedient to use steam driven machinery. One of the greatest advantages is that the expense for power begins only when the motor is started and entirely ceases when the motor is stopped. The author also pointed out the benefits obtained by providing each machine with its own motive power and to operate that machine at its maximum output. With the advantages of new high speed tool steels and the incentive of premium and bonus systems of payment, it is almost essential that each machine shall be capable of being driven to its maximum capacity, and since that maximum varies according to the work and material the necessity for an independent control of ample motive power appears.

On the subject of speed control, Mr. Houghton referred to the various methods used to accomplish this result. Special motors, he stated, are constructed with two independent armature windings which may be combined so as to produce the special speed changes desired, while in some instances storage batteries have been used. There seems to be a general opinion, however, that a greater range of speed variation is required than can advantageously be secured in the motor itself. To provide for the great number of speed changes necessary for lathes, boring mills and similar machines is more than can properly be demanded of the motor alone, but it may be accomplished by cutting in or out of resistance in speed controllers made for the purpose. If a grinding machine is to produce its highest output the speed control must be readily obtainable, not only to correspond with the quality of the wheel used and the work on which it is used, but sufficient to compensate for the wear in the diameter of the wheel. It is very important that the periphery of the grinding wheel should be kept at the maximum cutting speed at all times. Mr. Houghton also pointed out the importance, in equipping machine tools with motors, to avoid the adoption of any apparatus which would require additional mental or manual labor on the part of the workman. Any extra duty of either kind will result in one of two things—either from divided attention the quality of the product will suffer, or, what is more likely, the operator will not use his equipment to the best advantage and the quantity of the product will suffer. In either case, the proprietor will not receive full benefit from his investment.

Illuminating Test of the Vacuum Tube Lamp.

In the report of the April meeting of the American Institute of Electrical Engineers in our issue for May 4 mention was made of the tests upon three lighting equipments installed in the lecture room, which tended to show that the vacuum tube system was the most efficient. The vacuum tube lighting system consisted of a Moore tube lamp 176 ft. long operated at what was stated to be 14.8 hefners per foot, being fed automatically with nitrogen. The concealed incandescent lamp system consisted of 288 8-cp 119-volt ordinary carbon-filament



ASSEMBLY ROOM, UNITED ENGINEERING BUILDING, ILLUMINATED BY VACUUM TUBES.

incandescent lamps, located behind a cove. Each of these lamps was equipped with a Frink reflector. In this system there were used also three incandescent clusters, each containing six 25-cp carbon-filament lamps concealed by opalescent reflectors. The exposed incandescent lamp system was a temporary circuit of incandescent lamps installed to parallel the vacuum tube throughout its length. For this purpose there were used 90 16-cp, 3.5-watt, 117-volt incandescent lamps. The test showed that the vacuum tube system consumed 4150 watts at a power factor of .75; the concealed lamp system consumed 10,250 watts at unity power factor, while the exposed incandescent system consumed 5050 watts also at unity power factor. The tests of the consumption were made with the same instruments throughout. Measurements of the illumination throughout the room were made at nine stations by means of a portable General Electric illuminometer. Expressed in hefner-feet, the mean illumination for the vacuum tube system was found to be 3.68; for the concealed system 1.99, and for the exposed system 2.48. The tests would seem to indicate that the rectangle of vacuum tubing without reflector produced 48 per cent more useful illumination and required 18 per cent less power than the rectangle composed of bare incandescent lamps without reflectors. This corresponds to an increase of 80 per cent in

illumination for the same power, or a decrease of 45 per cent in power for the same illumination. On the basis of 4.3 watts per spherical candle-power for the 3.5 watt incandescent lamp, this corresponds to 2.4 watts per spherical candle-power for the Moore tube. The estimate given by Dr. Steinmetz in his remarks was 2.5 watts.

Electric Lighting in Europe.

Mr. Louis J. Auerbacher, vice-president of the Beck Flaming Lamp Company, has just returned from a trip abroad, during which he made a special study of the European electric lighting situation. He noted with much surprise the remarkable strides that the new high-efficiency incandescent lamps have made abroad. The tungsten, osmium and other similar lamps are installed in great numbers and have already practically displaced the regular type of incandescent lamp. This is no doubt due to the well-known economy of the lamps which appeals very strongly to the foreign shop-keeper, who usually calls a family council whenever he decides to spend over a dollar. As to arc lighting, practically no enclosed arcs are in use, the open arc and the luminous arc having the field to themselves. Here again, economy plays the important rôle, the poor economy of the enclosed arc putting it out of the race.

The luminous arc is very extensively used for municipal lighting. The method most in vogue is to fasten a wire cable between the houses on the street and suspend the lamps from the center about 35 feet above the ground. Looking down the street at a row of these lights, the effect is very good and the illumination all that can be desired.

Some new types of mercury vapor lamps were observed in Paris, having bowl-shaped globes about 12 inches in diameter and 15 inches deep, containing two mercury vapor tubes, serpentine in shape. The Carbone lamp is making headway in Europe. This is a semi-enclosed lamp, having an efficiency between the open arc and luminous arc, and giving a brilliant white light. One of the reasons for the favor with which this lamp is meeting is the fact that it burns about thirty-four hours on one trim of carbons; otherwise it could not be considered in competition with the luminous arc.

Railroad Night Signals.

In a very interesting article, Mr. G. M. Stratton, discussing railway disasters at night, in the May *Century* says: The plan that I would propose would be to use throughout the twenty-four hours the kind of signal which is now employed only by day. * * * This could be accomplished simply by making at night the vane of the semaphore luminous. As, in our cities, lights are arranged in lines and letters to catch the attention, so here the signal could become a fiery arm pointing outward or down or, if need be, midway between these directions, at will. Such a line of fire would be strikingly different from the usual lights of buildings or of streets. It would also, both in quality and in form stand out entirely distinct from all the colored lights whose use upon the railway it may, in the end, seem wise to continue for purposes other than the block signal. A continuous line of light, moreover, would be visible at a far greater distance than is the present single light. The glowing signal lights would best be white, and of course should not change in tint in order to convey their message. This would at once remove all need of discerning whether the line burned white or green or red, with all the risk which the distinction brings.

The mechanical difficulties of introducing the new form of signal would not be great. A row of half a dozen oil-lamps stretched along the front of the signal arm—lamps of the type at present used in the block system—could be counterpoised to prevent their interference with the proper action of the mechanism which controls the arm. Even with such lanterns the new system would have an immense superiority over the old, but no one should regard these weak lights as more than a makeshift; for what is urgently needed is something that will penetrate the smoke and mist and storm. There would be many advantages in using incandescent electric lights throughout the large area where a suitable current is now available—an area rapidly increasing, and doubtless destined soon to cover nearly our whole land. The objection to the use of electric lights, that they are liable suddenly to fail if for any reason the current is interrupted, would not be serious where electricity is also the motive power of the trains; for, should the current cease, and the signal lights go out, the train would at the same time soon be brought to a stop, and there would be no immediate danger from the interruption. But on roads where electricity is not the motive power, the best illuminant for the new signal would perhaps be gas stored under pressure in tanks—gas such as is used in many of our railway cars or in the gas buoys set along our shores by the government. Since these buoys burn untended for months in storm or calm, it would seem that such a light might well be adapted to illuminate the semaphore arm. For if a line of oil lamps were used, the temptation would be strong to economize in weight and consequently in oil capacity, and thus to have only a moderate brilliancy where a powerful light is needed.

Electricity Versus Steam in Shop Operation.

At a recent meeting of the Southern & Southwestern Railway Club, held at Atlanta, Ga., two papers were presented on the subject of electricity versus steam in shop operation, the author of one being Mr. J. H. Klinck, of the Westinghouse Company, and of the other, Mr. H. P. Powell, of the General Electric Company. Mr. Klinck stated that in a comparatively recent instance a plant which required an average output of 300 hp when belt-driven, was converted to electric drive and the average load became approximately 150 hp. In a railroad shop the importance of the losses is relatively great, for the reason that much of the work is done on over-time. At these times the power utilized is extremely small as compared with that wasted, as only a few tools are in operation at once. In the design of an entirely new shop equipment the limitations of the engine-driven plant are very apparent. With this type of installation driven from a central power plant, it becomes necessary that the buildings making the heaviest demands on the power plant be located adjacent to it. By doing away with long lines of shafts and making possible the use of individually-driven tools, the electric motor has proved to be one of the most powerful agents in the development of the present highly efficient railway shop. Moreover, it has enabled the service of the overhead crane to be utilized. Many arguments may be given in behalf of the electric equipment of railway shops, but the very strongest reason for the use of this type of equipment is the single fact that those roads which have installed it—at first, perhaps, with many misgivings—are now its ardent advocates. There are available two general types of electrical apparatus, the alternating-current and the direct-current, each of which has its own peculiar advantages and its own field of special fitness. In most of the recent large installations a combination of these two systems has been used, the main generating units being of the polyphase type with rotary converters for furnishing the required amount of direct current.

Mr. Powell stated his belief that seldom less than 40 per cent of the power consumed in a steam-driven machine shop is used for driving unnecessary shafting and belting. He described experiments carried out in the shops of the General Electric Company in which two 72-in. cast-iron disks were cut down to a minimum diameter of 6 inches. With a mechanically-driven tool using three-step cone pulleys, the work required 59 minutes; with an electrically-driven tool, operated by a variable-speed motor, the work was accomplished in 31 minutes. Thus the belt-driven tool required 90 per cent more time to do the work than the electrically driven one. For electrical equipments Mr. Powell considered that the simplest and best method

is the one requiring the use of the two-wire system with the speed variation obtained by field control. By the use of the commutating-pole type of motor, giving from 100 per cent to 400 per cent speed regulation, the varying requirements of almost any tool can be met at a slightly increased cost over constant-speed or standard-speed motors. The choice of the exact type of motor to be used is largely influenced by the work to be done. Shunt-wound motors have very good speed regulation under various fluctuations of load. In the case of machines which either run very slowly with sudden and intermittent loads, or of machines having parts whose inertia requires the expenditure of much energy for any considerable change in speed, compound-wound motors are better. It is advisable to use fly wheels in connection with compound-wound motors on such machines as punches, shears, planers and similar apparatus. In many classes of tools, especially those making slow, intermittent and heavy cuts, the value of a fly wheel either on the motor shaft or on the power-receiving shaft of the machine tool cannot be over-estimated. Cranes, hoists and winches are usually equipped with straight series-wound motors because they are capable of exerting a very high starting torque. Series-wound motors are also usually employed with large boring mills and similar machine tools.

Electric Railway Engineering at Cornell.

The seniors in electrical engineering and in mechanical engineering in Sibley College, Cornell University, are manifesting great interest in electric railway work. About 110 are taking the general railway lectures, and one-half this number are in the more highly specialized course. The interest has been greatly stimulated by means of non-resident lectures by Mr. C. O. Mailloux and by Mr. W. N. Smith, of Westinghouse, Church, Kerr & Co. Mr. Mailloux's lectures dealt with velocity-time curves and mechanical integration as applied to their manipulation.

The series of six lectures now being delivered by Mr. Smith have the following topics: 1. Preliminary examination to determine the status of the railway project. 2. Topography, train tonnage and time tables. 3. Speed time curves and other methods for power determination. 4. Working conductors, trolley, third rail and transmission lines. 5. Substation and power house location and equipment. 6. Steam versus electricity in operation. The lectures are intended to embody an exposition of the data needed and results to be secured in the development of the poewr and equipment required for electric railway projects. The course is only concerned incidentally with the civil engineering features of railway construction. The idea is to tell young engineers what information to go after and how best to make use of it after it is secured.

Such courses as this are given only in the latter half of the senior year. Up to that time the students are occupied with routine studies intended to train them for their practical work. It is felt, however, that in the last term the students should be given a general idea of the manner in which mechanical and electrical principles are applied to various phases of engineering work. Information courses are not considered to be of value, but illustrative material must be given to students at the proper time in order to fix in mind the principles and to produce a feeling of confidence in their applicability to practice.

Automatic Telegraphic Transmission.

There are two ways in which a greater volume of telegraph business may be transmitted from one city to another in a given time; first, by increasing the number of wires, and second, by increasing the speed of transmission, the number of wires remaining the same. The latter seems the more feasible way of solving the problem and many systems of rapid (machine) telegraphy have been invented to transmit business between large centers at high speed. For various reasons many of them have failed to meet the requirements and have passed into history. Some, however, have proved highly meritorious and are being extensively used on heavy circuits between large cities in this country.

Mr. Walter P. Phillips, who was for many years general manager of the United Press, and who is an old-time telegrapher, has given much thought to the subject of high-speed transmission and has done some good work in that direction. He has just been granted a patent on an improvement upon the system of machine telegraphy invented jointly by himself and the late Roderick H. Weiny. The messages to be transmitted are first recorded at the sending station by an apparatus operated by an ordinary hand transmission key, which embosses the messages in Morse characters on a paper tape. This tape is then run through a suitable transmitter by means of which the signals are sent over the line to a second embossing apparatus, by which the record is reproduced on a similar tape. This latter tape is then passed through a second instrument similar to the transmitter or divided into sections and used for operating a number of such instruments, which in their turn operate a sounder or sounders from which the messages may be read and transcribed.

This system, designed to meet the requirements of the practical operation of long circuits, particularly those which are occasionally overcrowded, enables several Morse operators at a sending-station to record at a comparatively slow rate a large number of messages which may be transmitted and recorded with great rapidity and reproduced at any desired slower speed at the receiving station, where they may be read by sound and transcribed in the usual way by the operator. The most important consideration in such a system is evidently, therefore, the provision of means for the rapid transmission and accurate recording of the mesages in Morse characters on a tape at the sending and receiving stations, but more especially at the latter, and to secure this result is the special object of Mr. Phillips' improvements. In this way a very much larger volume of business can be carried on over a circuit, whether single or multiplex, by ordinary Morse operators than would be possible under ordinary working conditions.

The Installation of Double and Single Pole Switches.

As the "Code" rules are at present, if it is desired to install a switch other than the service switch, to control lamps requiring more than 600 watts, it is necessary for this switch to be double pole. An installation for lighting, however, may be made of any capacity without any switch other than the main service switch; that is, each lamp may be controlled independently at the key socket.

In knob and tube work, where wiring for flush switches, the space is often limited, and if the switch is to control circuits supplying devices requiring more than 600 watts, both sides of the circuit must be brought to the switch, which to properly install is oftentimes difficult.

Single pole switches, of the rotary and knife pattern, have been used on street railway work for years with good success. There seems to be no reason why a single pole switch should not be permitted when installed where under the rules no switch would be required. It will be noted that the changes made at the last meeting of the National Board of Fire Underwriters do not modify the rules pertaining to switches for services, or for motor or heating devices.

The changes made are as follows:

Rule 17, Section *a*. To read as follows:

On constant potential circuits, all service switches and all switches controlling circuits supplying current to motors or heating devices, and all cut-outs, unless otherwise provided (for exception see No. 8, *c*) should be so arranged that the cut-outs will protect and the opening of the switch or circuit breaker will disconnect all of the wires; that is, in the two-wire system the two wires, and the three-wire system the three wires, must be

protected by the cut-out and disconnected by the operation of the switch or circuit breaker.

Fine print note:

This, of course, does not apply to the grounded circuit of street railway systems.

Rule 22, Section *c*. To read as follows:

Single pole switches must never be placed in the neutral wire of a three-wire system, except in the two-wire branch or tap circuit described in 21, *d*.

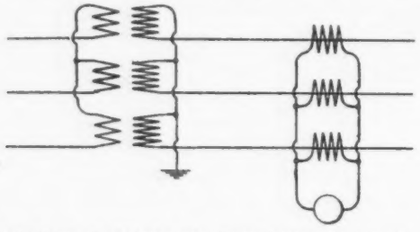
Fine print note:

Three-way switches are considered as single pole switches and must be wired so that only one pole of the circuit is carried to either switch.

Rule 75, Section *a*. Strike out section.

Leakage Indicator for High-Tension Lines.

With circuits arranged as indicated in the accompanying illustration, when there is no leakage to ground on the grounded side of the potential transformers, the algebraic sum of the currents at any instant in the primaries of the current transformers is zero; the secondary currents of the transformers will, therefore, exactly neutralize each other and no current will flow through the ammeter. If leakage to ground occurs on any one



LEAKAGE INDICATOR FOR HIGH-TENSION LINES.

wire, the currents in the series transformers will no longer exactly balance each other and a resultant current will be produced in the ammeter, proportional to and in phase with the leakage current. A patent granted to Messrs. J. E. Woodbridge and J. B. Taylor on April 23 claims the means by which the above-mentioned phenomena may be employed in constructing a leakage indicator for high tension lines.

Self-Starting Single-Phase Induction Motors.

When a three-phase motor is operated from a single-phase circuit it is necessary to use some phase-splitting device for the purpose of bringing the rotor up to speed. When the split-

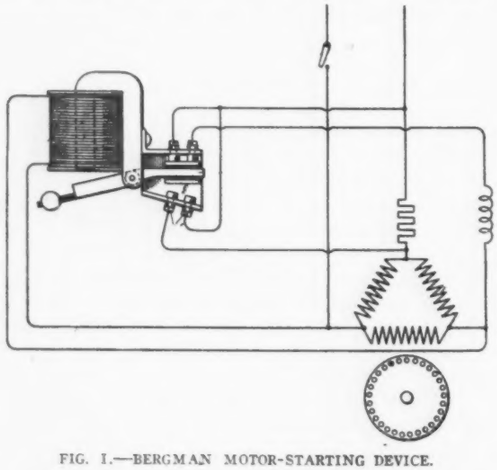


FIG. 1.—BERGMAN MOTOR-STARTING DEVICE.

phase method of starting is used, while the rotor is stationary there exists a cross-field in space quadrature and in time quadrature with the main field. The cross-field is much weaker than the main field of the motor so that the resultant field shape is elliptical. As the rotor speed increases, currents which are produced in the second winding strengthen the cross-field until when the rotor is at full speed there exists a substantially true revolving field. In view of these facts it is obvious that any portion of the motor winding having a different mechanical position from the portion which is connected across the source of supply, will be the seat of an induced e. m. f. having a com-

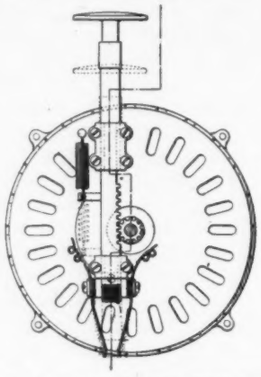
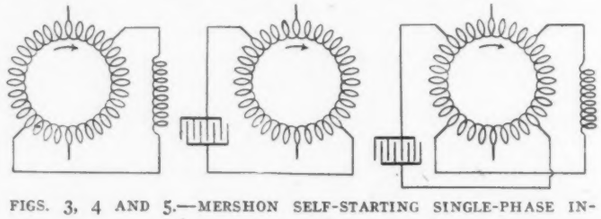


FIG. 2.—GURY MOTOR-STARTING DEVICE.

ponent in electrical time quadrature with the impressed e. m. f., which will increase as the rotor speed increases. A patent issued April 16 to Mr. S. R. Bergman discloses means for utilizing the above-mentioned phenomenon for automatically cutting out the phase-splitting device when the rotor is up to speed. As shown in Fig. 1, an electromagnet is connected across one of the phase windings which is least active during the starting period. As the speed increases, more and more current is produced in the magnet winding until at a predetermined speed the pull of the magnet is sufficient to open the switch in the phase-splitting circuits and to close a switch which short-circuits the phase-splitting resistance, thereby causing the machine to operate as a plain single-phase induction motor.

The problem of rendering a single-phase induction motor self starting has been solved mechanically by Mr. J. B. Gury, as disclosed in a patent issued April 23, from which Fig. 2 has been taken. The starting switch is mechanically arranged on a manually operable slide bar having a toothed ratchet which engages with a pinion on the armature shaft. When the slide bar is rapidly depressed the armature is thrown into rotation immediately before the main circuit switch is closed. A catch mounted on the armature frame serves for holding the slide bar in the depressed position when desired. The mechanical arrangement is such that the armature is permitted to continue in rotation without any unusual friction.

A patent issued April 30 to Mr. Ralph D. Mershon describes a method for obtaining a uniformly or approximately uniformly rotating field in a single-phase induction motor under starting conditions. The elements of the scheme are shown in Figs. 3 and 4, while the complete device is indicated in Fig. 5. Fig. 3 indicates an inductive reactance connected to the primary element of a two-pole single-phase induction motor across an electrical diameter at about 45 electrical space degrees from the main terminals. It is stated that with this connection an



FIGS. 3, 4 AND 5.—MERSHON SELF-STARTING SINGLE-PHASE INDUCTION MOTOR.

unsymmetrical rotating field is produced, giving a torque in the direction indicated by the arrow. No explanation is given as to the causes for the mechanical movement of the field or as to the source of the torque. In Fig. 4 a condensive reactance

is substituted for the inductive reactance of Fig. 3. According to this connection an unsymmetrical revolving field will be produced, and on account of the electrical space displacement of the condenser circuit from the main terminals the tendency to rotation will be in the same direction as indicated in Fig. 3. The inventor proposes to combine the action obtained with the connections of Fig. 3 with that of Fig. 4, as indicated in Fig. 5. It is claimed that by properly proportioning the values of the inductive reactance and the condensive reactance, the rotating field in the motor will be approximately uniform, so that a maximum starting torque is obtained. By giving to the capacity of the condenser a sufficiently high value, the leading current which it takes directly from the main circuit and the exciting force which it supplies to the magnetic field may be made to compensate for and reduce the lagging magnetizing current in the supply circuits of the induction motor, and thus the power factor may be given any desired value under running conditions. Evidently the best results will be obtained when the inductive reactance is omitted.

Philadelphia Meeting of the American Electrochemical Society.

The eleventh general meeting of the American Electrochemical Society was held on May 2, 3 and 4, at the John Harrison Laboratory of Chemistry of the University of Pennsylvania—in the same hall where the society had been founded five years ago. It is a pleasure to state that the enthusiasm ran just as high as on the former occasion and it may be expected that the great success of this last Philadelphia meeting will act as a kind of inspiration and as a new strong impetus towards further activity. The next meeting will be held in the autumn in New York City, and the very active and strong New York Section of the society will do its best to attain a success not less than that of Philadelphia.

The number of members which registered passed the 100 mark on the first day, and when Dr. C. P. Steinmetz delivered his admirable address on Friday morning there were almost 200 members and guests present.

After the president, Mr. Carl Hering, had called the meeting to order, Prof. E. F. Smith, vice-provost of the University of Pennsylvania, extended a most cordial welcome to the society and gave an outline of what has been done at the University of Pennsylvania for the sake of electrochemistry, in the times of Robert Hare, as well as in recent years.

The report of the annual election of officers was then read. The new president is Prof. C. F. Burgess, of the University of Wisconsin, the new secretary, Prof. J. W. Richards, of Lehigh University. Mr. P. G. Salom was re-elected treasurer. The three new vice-presidents are C. E. Acker, A. H. Cowles and W. H. Walker, the three new managers E. F. Roeber, S. S. Sadtler and L. Kahlenberg. Mr. Hering then read his presidential address.

AMERICAN ELECTROCHEMICAL SOCIETY.

Mr. Carl Hering's presidential address dealt with the society itself, its past, present and particularly its future. Mr. Hering gave a brief review of the history of the society showing in curves the fluctuations of its membership, attendance at meetings, finances, etc. Another diagram gave comparative curves of the growth of the Bunsen Society in Germany, the American Electrochemical Society and the Faraday Society in Great Britain. The American society has grown more rapidly than any of the others and is now nearly as large as its older sister society in Germany. While the annual fee of $5 seems very low, Mr. Hering does not advocate raising the dues, since there is no immediate necessity for it if the management continues to exercise strict economy.

Concerning the question whether two meetings or one meeting should be held in a year, Mr. Hering advocates what he calls a mean between the two plans, that is to let the large spring meeting be the important one and then hold a less pretentious and shorter meeting in the fall in a central location, like New York City, where there is a large local section and a large local membership. It might perhaps be held under the auspices of the local section. The last meeting in New York City was intended to be a test of this plan, but unfortunately it was encumbered by a number of mishaps which it would be unjust to assume to be normal conditions. Mr. Hering therefore urges trying it again next fall and getting the large and active New York local section to assume the responsibility of its success. To omit one meeting entirely would, in his opinion, be the beginning of decadence of the society, resulting ultimately in its absorption by some larger society. By far the greater number of members have joined for the sake of the *Transactions*, and many of these would be unwilling to pay dues for only one volume. The *Transactions* are one of the chief attractions and assets, and they should be guarded zealously.

The last part of the address dealt with a tentative proposition which has been brought up recently from the American Chemical Society and which was originated by Dr. W. A. Noyes. The two basic features of the proposition are to combine into one monthly publication all papers on physical chemistry and electrochemistry read before either society, and second, to reduce the cost of the publications of both societies by having the work done by one publication board. It is proposed also to combine the *Journal of Physical Chemistry* with this new joint publication.

In his long discussion of this proposition, Mr. Hering maintains that such a combination of publications is of mutual advantage, is very desirable and should be accomplished if possible. If entered into, it should be done with a view of permanency, and not as an experiment, and therefore the arrangements should be such that they should be as equitable in the future under changed conditions as they are to-day.

Mr. Hering has elaborated a careful plan of the division of expenses to do justice to all sides. It would be important that the American Electrochemical Sociey should not by any such combination lose its independence or subject its papers to the censorship of any other society and the carrying out of any such plan should not jeopardize the future existence of the society.

It was decided at the meeting that no final arrangement should be made by the board of directors, but that if the special committees appointed to consider the question, and the boards of the two societies should be able to agree on a proposition, the proposal should then be put before all members of the society to be voted upon by mail.

EFFICIENCY CONSIDERATIONS.

Mr. W. R. Mott presented a brief paper on "Some Efficiency Considerations of an Electrolytic Cell." By means of diagrams he showed the relation between efficiency and current density, and the corresponding relations between voltage and current density. He pleaded for expressing the rate of chemical corrosion in terms of current density and pointed out that in many cases the energy efficiency (watt-hour efficiency) is of greater practical importance than the ampere-hour efficiency.

CHANGES OF CONCENTRATION AND MIGRATION VELOCITIES.

A brief paper by Mr. C. J. Reed intends to prove that changes of concentration cannot be caused by unequal migration velocities of the oppositely charged ions. His argument is based on the consideration of a cell with one electrode at each end. He assumes two arbitrarily fixed cross-sectional planes between the two electrodes and considers the space between these two planes. He shows that the number of ions of both kinds in this space remains unchanged by the migration of the ions. Mr. Reed argues that since the location of these planes is arbitrary it will hold true for the whole electrolyte.

"Furthermore, it follows that since no changes in concentration could be produced in the body of an electrolyte by an inequality in the constant velocities of the oppositely moving ions, there would be as a result of such an inequality, an accumulation of oppositely charged ions at the two electrodes which would be proportional to their two velocities. This would be

contrary to Faraday's law and contrary to the facts. The assumption of unequal velocities is, therefore, not only incompetent to explain changes in concentration, but is in direct contradiction to the most thoroughly established facts in electrochemistry."

ELECTROLYTIC ANALYSIS.

Prof. Edgar F. Smith, of the University of Pennsylvania, then presented an exceedingly interesting paper on "Recent Developments in Electrolytic Analysis." He gave an outline of the great progress which has been made in recent years in his laboratory by himself with the collaboration of his students, chiefly by using a mercury cathode with a rotating anode. For example, an analysis which formerly took hours can now be finished in 10 minutes. Progress made in the analysis of various chlorides, sulphates, fluorides, etc., was especially dealt with, and the apparatus which have been devised for this work were exhibited. Prof. Bancroft and Prof. Chandler expressed their admiration for the work described in the paper, which was also briefly discussed by Dr. Walker and Dr. Patten.

WORK DONE IN ELECTROLYSIS.

Prof. J. W. Richards presented a paper on experiments in which he endeavored to calculate the decomposition voltage from thermochemical measurements. The electrolytic cell was placed in a thermostat and the rise of temperature during electrolysis was measured. The total energy of the current which passes through the cell is known in volt-ampere-seconds and may then be calculated in calories. The heat which appears in form of sensible heat is found from the rise of temperature and the specific heat. The difference between the two amounts of energy represents the electrochemical work of the electric current, in calories. If its corresponding value is found in volt-coulombs and if this figure is then divided by the amount of coulombs which have passed through the cell the voltage of decomposition is found. By this method the author found 1.61 volt to be the decomposition voltage required to set hydrogen and oxygen gases free from an acid solution.

PICKLING OF STEEL.

In a paper on this subject presented by Mr. C. J. Reed, a method of removing an oxide scale from iron by cathodic reduction is described. The iron is made cathode in a sulphuric acid solution and the oxide is reduced by the current to a lower state of oxidization and then dissolved. The solution of oxide is effected without dissolving any of the iron, which latter is the case in processes in which the article is made the anode.

PYROMETRY.

The first paper on Friday was presented by Dr. George K. Burgess, of the Bureau of Standards, on "The Estimation of High Temperatures." The generally recognized temperature scale up to 1200 degrees C. is that of the gas thermometer. The scale as defined by various gases is also practically identical and "we may say with considerable positiveness that the temperature scale is known to within three degrees C. up to 1200 degrees C."

Convenient fixed points are the freezing points of pure metals, thus, such as tin 232.10, zinc 419.00, aluminum 658, antimony 630.5 and copper 1084.1. The determinations of these points with various commercial pure metals bought from different sources in this country show that, with the exception of antimony, the other metals may easily be obtainable in this country in sufficient purity to reproduce the temperature scale with great exactness.

Above 1200 degrees C. there is as yet no generally accepted temperature scale and extrapolation in terms of some phenomenon varying with the temperature must be resorted to. The author first discusses the use of thermo couples and then that of radiation methods.

By thermoelectric estimation of the melting point of platinum was found to be 1710 degrees C. by Harker at the (British) National Physical Laboratory, 1710 degrees by Holborn and Henning at the German Reichsanstalt, and 1706 by Waidner and Burgess at the National Bureau of Standards in Washington. These values are certainly very concordant.

An optical estimation of the melting point of platinum (on the basis of Wien's law) by Nernst and Wartenberg gave 1746 degrees C., by Holborn and Valentiner 1789 degrees C. and by Waidner and Burgess 1753 degrees C. This difference may in a great measure be attributed to the value of one constant, assumed by the different observers, in Wien's law which is the basis of these determinations. More work must be done before the value of this constant is satisfactorily determined.

It is evident, however, that the optical scale, howsoever interpreted, gives temperatures considerably higher than does the extrapolation by means of thermo couples. The following corrections must be added to thermoelectric determinations making use of the empirical formula $E = a + bt + ct^2$ to give temperatures in terms of the optical scale as determined at the Bureau of Standards, which latter scale represents the "true temperature" with greater probability than does the thermoelectric extrapolation.

Temperature on Thermoelectric Scale.....	1200°	1300°	1400°	1500°	1600°	1700°
Optical Thermoelectric...	0	+2	6	14	25	43

It is also possible to make use of the intensity of radiation from the exposed surface of refractory material, as platinum, in order to measure its temperature, when the departure of the substance from ideal blackness has been determined. The relation between the black-temperature using red light and the true temperature has been determined for platinum with considerable precision. The readings of an optical pyrometer sighted on a platinum strip may therefore be interpreted readily in terms of true temperatures. Use may be made of this principle to determine the melting points of substances in very minute quantities. As an illustration of this method the approximate melting points of the iron group are given as follows: Iron (99.95 per cent pure) 1507 degrees C., cobalt 1464, nickel 1435, manganese 1207.

Our knowledge of the numerical values to assign to very high temperatures—that is, above 1800 degrees C.—is still in the formative stage and no very positive statement can be made at the present time. Here we must rely on the laws of radiation and the author thinks that the Stefan-Boltzmann law for the total radiation has the most satisfactory theoretical basis, but it appears to be much more difficult experimentally to get accurate results using the total radiation method or the Stefan-Boltzmann law than when using the spectral radiation method or Wien's law.

ELECTRIC CONDUCTION.

By invitation of the board of directors, Dr. C. P. Steinmetz then presented an exceedingly interesting experimental lecture which was very highly appreciated by the crowded audience. While the title on the programme was on the conduction of vapors and gases, Dr. Steinmetz proposed to speak on electric conduction in general. There are phenomena outside and inside of a conductor. Outside there are electromagnetic and electrostatic stresses and inside of the conductor conversion of electric energy into heat.

It is usual to distinguish different classes of conduction. The briefest definition of metallic conduction is perhaps that metallic conductors are those in which energy is converted directly into no other form but heat. They have in general a positive temperature-resistance coefficient, but this rule does not hold for alloys.

Electrolytic conduction is always accompanied by chemical action. The resistance of electrolytic conductors is in a general way about one million times higher than that of metallic conductors. As a rule, electrolytic conductors have a negative temperature-resistance coefficient.

Thirdly, in the cases of gases and vapors much work has been done in recent years to extend the ionic theory (which originated from electrolytic conductors) to the conduction of gases and vapors. Dr. Steinmetz thinks these are mere theo-

retical speculations or rather pictures of what happens, but not facts. Such hypotheses are often useful, but may later on be discarded or, as is now the practice, they are amended and reamended for the sake of continuity so that a hypothesis may become later on something quite different from what it was before. Since there are enough disturbing factors in the actual experimental measurements, Dr. Steinmetz proposes not to introduce another source of error, namely, theory. He proposed to deal simply with experimental facts.

In gases and vapors there are two different classes of conduction. First, the electric discharge (Geissler discharge at reduced pressure and the spark at ordinary pressure) is characterized by the fact that the discharge passes through the gas and vapor which already fills the space. Second, the arc is characterized by the fact that the current is conducted through a vapor which is produced by the arc itself from the material of the electrodes. The arc is continuous, the discharge is discontinuous.

By spectroscopic measurements or by simply looking at the arc it is possible to determine what the material is which carries the current. A positive magnetite electrode with a negative carbon electrode give the carbon arc. A negative magnetite electrode with a positive carbon electrode give the iron arc. A negative magnetite electrode and a positive copper electrode give also the iron arc. These are illustrations of the general rule that the material which produces the vapor and transports the current in an arc is that of the negative electrode.

In general, an alternating current cannot maintain an arc (carbon being an exception) just for the reason that the arc requires a vapor stream from the negative electrode and with alternating current the electrodes change their polarity every half period. Alternating current arcs are possible only with materials whose boiling points are so high that the disruptive voltage is higher than the voltage required to maintain the arc. As a general rule one can shift from positive to positive electrode, but not from negative to negative. Thus continuity at the negative is absolutely essential.

With respect to the resistivity-temperature curves it is easy to classify, but one always finds exceptions. Dr. Steinmetz referred to a whole class which does not fit into the usual classification—the pyro-electric conductors which have a temperature-resistance characteristic of their own. No strict classification is possible. While we speak of "classes" of electrolytic or metallic conduction they are really "types" of such conduction. The most interesting materials to be investigated are not the typical cases, but those on the border lines. By studying them we will be best able to learn what electric conduction really is.

ELECTRIC DEPOSITION OF ZINC.

A paper by Ralph C. Snowdon was then read in abstract by Prof. Bancroft. The paper gives the results of some experiments on the electro-deposition of zinc and on the effect of those factors which determine the quality of the deposit. It was found that the limiting current density at which the zinc deposit begins to become bad depends more on the rate of stirring than on all the other factors combined. Good deposits of zinc may be obtained from acid or alkaline solutions even at such high current densities as 60 amperes per square decimeter. The rate of rotation of the cathode has an enormous effect on the upper limit of the current density. Since zinc will precipitate readily from strongly alkaline solutions, the resistance of these solutions and consequently the voltage across the terminals can be made very low for any given current density.

A PRACTICAL LIMITATION OF RESISTANCE FURNACES—THE "PINCH" PHENOMENON.

A paper on this subject was presented by Mr. Carl Hering. Reference to this phenomenon, discovered by Mr. Hering, was made on pages 492 and 513 of our issue for March 9 in a report of a paper by Dr. E. F. Northrup, who has worked out the theory of the phenomenon and made practical applications of it.

Mr. Hering's paper dealt with the application of the phenomenon to resistance furnaces. It has often been said that by simply increasing the watts per cubic inch in a resistance, any desired high temperature may be reached, up to that of volatilization, which means the destruction of the resistor. This has been considered the only limitation. This, however, is not the case. A limit may be reached which is far below this temperature, due to the pinch phenomenon, and this limit may at times be a very serious one, as it is sure to exist, and may sometimes limit the temperature to such a low value as to entirely defeat the object of the furnace.

When the current density in a liquid conductor in an open channel is increased sufficiently, the conductor will be found to contract in cross-section with considerable force, especially at a place where there is some slight obstruction in the channel, or where, for any other reason, the cross-section is less than the average. This contraction resembles the depression in plastic material that has been pinched between the fingers; as the column of liquid looks as though it were being pinched by some mysterious and invisible force, the writer termed it the "pinch phenomenon," for want of a better name.

With respect to the construction of resistance furnaces, Mr. Hering pointed out that to prevent the trouble the channel should be made as perfectly uniform as possible and kept free from obstructions. It should also be made as deep as possible, and since it is not desirable to have it very narrow it also should be as wide as possible. Hence, both depth and width should be made large, which means short channels, low voltages, enormous currents, or else a large capacity of the furnace. In other words, the danger from this source is greatly increased as the furnace becomes smaller in capacity. Some idea of the strength of this contracting force may be had from a case in Mr. Hering's experience, in which the V-shaped depression extended down as much as 6 ins. through molten iron to the bottom of the channel, causing a complete rupture, followed by freezing, which necessitated the dismantling of the furnace.

CARBON AND MAGNESIA.

A paper by Dr. O. P. Watts on "The Action of Carbon on Magnesia at High Temperatures" was then presented in abstract by Prof. Burgess. In using the magnesite brick for lining and carbon as a resistor, the observation was made of the condensation of what appeared to be lampblack. In another case when magnesite tubes were baked in carbon the magnesite tubes disappeared completely, leaving a groove where they had rested in the carbon. Dr. Watts thinks that a definite compound has not been formed, but rather a physical mixture of Mg O and carbon. The paper was discussed by Messrs. Richards, Reed, Bancroft and Potter.

CORROSION OF IRON.

The last paper of the Friday session was presented by Dr W. H. Walker on "The Influence of Strain on the Corrosion of Iron." The results were given in diagrams shown by lantern slides.

POLARIZATION VOLTAGES.

The first paper presented at the Saturday meeting was by J. A. Wilkinson and H. W. Jillett on the polarization voltages of silver nitrate solutions. Some qualitative experiments having shown that the decomposition voltage for solidifying nitrate solutions varied with the concentration of the acid experiments were made to determine the various factors. The general results are that the polarization e. m. f. of acidifying nitrate solutions may be made to vary from 0.625 to 1.05 volts. It changes with variations of temperature and the proportion of silver nitrate, nitric acid and water.

RAPID DETERMINATION OF ELECTROLYTIC RESISTANCE.

Prof. C. F. Burgess then presented a paper on the "Rapid Measurement of Electrolytic Resistance." The author pointed out that an increase in the amount of various acids and salts in aqueous solutions of from 5 to 10 per cent produces a decrease of approximately 10 per cent in the specific resistance, while the corresponding variation in the specific gravity is in the neighborhood of 3 per cent. The sensitiveness, therefore,

of a resistance measurement as a means of determining the strength of a solution is materially greater than that of a density measurement.

The author described a simple method of resistance measurement by which the time and trouble required for taking a reading is little greater than that needed for determining the temperature by means of a thermometer, or the specific gravity by a hydrometer. Moreover, the results are sufficiently accurate for many technical purposes.

The method is based on the fact that a resistance placed in series with a voltmeter and a battery decreases the voltmeter reading. The apparatus may consist of a glass tube with suitable electrodes, an ordinary voltmeter and a series of a few dry cells. The glass tube is simply immersed in the electrolyte to be tested and thereby the column of electrolyte between the two electrodes is placed in series with the voltmeter and consequently decreases the voltmeter reading. There is, of course, a switch provided which enables one to connect the voltmeter with the dry cells alone or with the dry cells in series with the column of electrolyte. With the electrodes fixed at a certain distance apart and with a constant source of e. m. f., a voltmeter may be callibrated so as to give directly the specific resistance.

The paper was discussed by Mr. Hering, who suggested other suitable methods.

HELION LAMP.

Prof. H. C. Parker presented a paper on the helion lamp and showed some lamps in operation. The progress recently made in incandescent lamps is due to the use of higher temperatures. The higher the temperature of the filament, the colder the light. In the design of electric filament lamps it is not the melting point of the filament but the point of vaporization which is of importance. Pure silicon has a melting point of 1400 degrees C., but to get an illumination of one cp per watt a temperature of at least 2100 degrees C. is required. It seems therefore almost hopeless to try silicon. But Prof. Parker claimed that silicon has the lowest vapor tension of anything known. In this respect at least it was promising, and that is the starting point of Mr. Clark's work.

While others believe that the filament of the helion lamp is a silicon carbide, Prof. Parker claims it is pure silicon but in a different allotropic state than ordinary silicon. The relation of "helion" (the name given to the material of the filament of the lamp) to ordinary silicon is, he stated, the same as that of the "metallized" graphite of the General Electric Company to ordinary carbon. Prof. Parker therefore spoke of the "helion" lamp as a "metallized-silicon" lamp. The filament, he said, withstands a black-body temperature of 2300 degrees.

In the discussion attention was called by Mr. Clark to the temperature-light curve. If the characteristics of a carbon filament is taken and if the carbon filament is then coated with silicon and the characteristic is taken again then the light is found to be increased at any point of temperature.

The paper was also briefly discussed by Messrs. Gaster and Tucker.

NICKEL ZINC ALLOYS.

A paper by Prof. E. C. Schoch and Mr. Alcan Hirsch dealt with the electrolytic deposition of nickel-zinc alloys. The most interesting result of the investigation is that the decomposition tension of nickel is higher than the value obtained heretofore. This explains some former observations which were puzzling.

ELECTRIC DISTILLATION FURNACE.

Mr. E. R. Taylor presented a paper on a closed electric furnace for reducing and distilling metals from their ores. The furnace is especially intended for zinc reduction, but has not yet been tried on a large scale, though the experiments will soon be made. We have already referred to this new furnace of Mr. Taylor in our department on Recent Electrochemical Developments.

Abstracts of other papers read at the meeting will appear in our next issue.

Electrical Equipment of Cascade Tunnel.

It is stated that a contract has been placed by the Great Northern Railroad with the General Electric Company for four 100-ton, three-phase locomotives, each to be equipped with four motors. These locomotives, which will be geared and take current from an overhead system of 6000 volts, are designed for single speed with resistance control, the cascade connection not being used. It is also reported that a site for a power house has been located about 25 miles from the tunnel, where the conditions are such that adequate power is available. A 2-mile flume will here be constructed which will afford a head of about 140 feet.

The Cascade tunnel is 1440 feet long and the grade averages about 1.9 per cent, one end being about 240 feet higher than the other. If the results anticipated are obtained from the tunnel equipment, the entire Cascade Division of the Great Northern will be operated with three-phase locomotives, in which case locomotives on down grade will recuperate power. The Cascade Division is 60 miles long, half being on an up-grade and half on a down-grade of 1.9 per cent. The tunnel now being equipped is near the summit of the division. The electrical engineer of the project is Dr. Cary T. Hutchinson.

CURRENT NEWS AND NOTES.

LABOR TROUBLES IN SAN FRANCISCO.—According to newspaper despatches, San Francisco is practically without telephone service as a result of the strike of 500 operators. The girls demand $60 a month for all operators who have been in the service of the company for a year, but it is stated that the real fight is for the recognition of their union. On May 5 the employees of the United Railways & Electric Company also went on strike for an increase of wages and an 8-hour day, besides a full recognition of their union. The railway company has determined to fight the matter to a finish. It is stated that many of the employees are opposed to the strike. The linemen of San Francisco are also uneasy and are being urged to strike in sympathy with the telephone girls.

INCREASE IN CENTRAL STATIONS.—The new *Central Station List,* just issued by the McGraw Publishing Company, enumerates no fewer than 4962 central stations in the United States, Canada, Mexico and the West Indies. Canada accounts for 278, Mexico 38 and the West Indies 5. Of these plants no fewer than 2385 carry electrical supplies as part of their business. The issue reports 138 plants for the first time, of which 27 are in New York State, 8 in Texas, 5 in Georgia and 8 in Missouri. Of the grand total, New York reports 314 and Pennsylvania 311, but Illinois has no few than 355. Indiana has 199 and Wisconsin 173, but Ohio has 270 and Michigan 250. Texas reports the relatively large number of 186, and California accounts for as many as 141. Iowa also has the large number of 192. These ten States account for about one-half of the total number.

DINNER TO MR. F. P. FISH.—Mr. Charles F. Cutler, president of the New York Telephone Company, and Theodore N. Vail, the new president of the American Telephone & Telegraph Company, gave a dinner on the evening of May 7, at the Metropolitan Club, New York City, in honor of Frederick P. Fish, the retiring president of the American Telephone & Telegraph Company. Among those at the dinner were: George F. Baker, Alexander Cochrane, Charles A. Coffin, William N. Cohen, T. Jefferson Coolidge, Jr., W. Murray Crane, Zenas Crane, Edward J. Hall, Morris F. Tyler, William D. Sargent, Alexander Cameron, Henry S. Howe, George V. Leverett, Henry D. Lyman, John G. Milburn, Charles Neave, Sylvanus L. Schoonmaker, Charles Steele, John I. Waterbury, Levi C. Weir, Robert Winsor and Enos M. Barton. Mr. Fish is to take a vacation trip to Europe. It is stated that he will continue as counsel for the company.

CLEVELAND ELECTRIC CLUB.—The last meeting of the season of the Cleveland Electric Club will be held on June 5, at which a paper will be read by Mr. R. Norberg. The officers of the club for the season 1906-1907 are: President, Prof. Henry B. Dates; first vice-president, E. E. Raney; second vice-president, T. E. Adams; secretary, Geo. L. Crosby; treasurer, A. V. Shauer. The board of managers consists of M. C. Canfield and A. C. Eastwood.

AIDING MUNICIPAL OWNERSHIP.—The grand jury of Chicago has returned four joint indictments against an ex-chief of police and five police and other city officials for corruption in the police department in aid of the municipal ownership campaign of Mayor Dunne, who was beaten so emphatically at the recent mayoralty election. Mutilation of records, violation of the criminal code, and illegal collection of campaign funds are all charged.

AN IMPROPER MESSAGE.—The Russian newspaper *Sviet* is responsible for the following story: "When a band of terrorists recently rushed a somewhat remote postal telegraph suboffice with the command 'hands up' a cool-headed female operator managed to rattle off to the central office: 'Robbers are here. Help.' The message was sent before the robbers had noticed the presence of the woman. The terrorists calmly proceeded to loot the office safe and after they had departed the following reply to the operator's message was leisurely ticked off: 'Send a proper service message and assistance will be despatched.'"

THE PUBLIC UTILITIES BILL.—Last week, to fifty-one of the leading Chambers of Commerce, Boards of Trade, and other commercial bodies of the state, the Albany Chamber of Commerce sent formal notice of the State Conference to be held this week on Thursday for the consideration of the pending Public Utilities bill. Each organization is requested to send five delegates. "The meeting is called," the notice says, "for the purpose of a discussion by business men of a business proposition. The Albany Chamber of Commerce does not commit itself to either side of the question, and no vote will be taken at the conference committing it as standing in favor or opposing the measure, and delegates must only come with this understanding."

ELECTRICAL GUN FIRING.—President Roosevelt declined to press the button at the opening of the Jamestown Exposition to start the machinery because the machinery was not ready to start. But he has no objection to such electrical "stunts." This week, on May 6, he fired a gun over a circuit of 515 miles, which is the distance between Washington and Charleston, S. C. The National Schuetzenfest convened at Charleston on Monday afternoon and the signal for the opening was the discharge of a rifle by the President through an electrical device. The President pressed a button in the White House and the rifle was fired at Charleston by the closing of the circuit. Beside the gun was a telephone receiver connected with a line running to the White House, and when the gun went off the President heard the report over the telephone. The rifle was trained on a target so that the bullet could hit the bull's-eye.

SYNTHETIC COPPER.—A remarkable report was given circulation last week to the effect that with the aid of "radium vapor," Sir William Ramsay, the famous English chemist, who isolated argon, had obtained "synthetic copper." Sir William proclaims it a hoax and says: "The only possible way I can account for the origin of the hoax about a synthetical process of copper making is that somebody gave a tremendous twist to something I said in a lecture two days ago before the Chemical Society, in which I discussed the effect of radium emanations on copper. The whole lecture was dry and unintelligible to the lay mind, and I never at any stage reached a point where I even said it was possible to manufacture copper synthetically." Sir William's name was recently connected with a process for extracting gold from sea water. There was not much more foundation for that story than for this copper yarn.

ELEVATED RAILWAY NOISE.—The Columbus Avenue property owners' committee in New York City, appointed to abate preventable noise of elevated trains, has applied to Corporation Counsel Ellison, at the mayor's request, to cause the city to enjoin the use of the third track now in use without public authority. The point has been made that the city is liable for all third-track damage since 1902, when such track was first adjudged without authority, because of its failure to abate the unlawful use of that track when requested by property owners. The engineer retained by the committee has made a report saying that the noise of electric motor cars can be reduced at slight expense; that a "block" wheel now used experimentally by the Pennsylvania Railroad, filled with oak, is practically noiseless and not patented, and that change from transverse to longitudinal sleepers on the elevated structure would render operation of trains practically noiseless at an expense not prohibitive.

ELECTRICITY IN LONDON.—A special cable dispatch from London of May 4 says: "Reform of the local government of London is already bearing fruit. The new County Council has already effected such economies that a reduction in the rate of taxation is announced. One of the chief scandals of the municipal ownership administration was in connection with the Works Department, which was wasteful beyond words. The new council has decided to obtain private estimates on all important work, and if their own engineers have figured a higher cost, then to award the job to a private contractor. The reform members of the new council met yesterday to decide what to do about the great electric scheme involving an expenditure of £25,000,000 sterling or $125,000,000, which was adopted by the old council. The plan contemplated a municipal monopoly of all electric supplies under municipal management. It was decided to promote a scheme for the consolidation of all London electric enterprises, including the erection of four great generating stations. The council is to have power to lease the undertaking to the consolidated companies under proper safeguards, including a limit of cost of two cents per unit of energy. It was agreed that under no circumstances would the council consent to operate the undertaking."

GOVERNMENT CONTROL.—The fact that the Government does not "control" when it owns and operates is a source of great anxiety in France, where the Government employees are all forming unions to promote their respective interests in regard to shorter hours, more pay, etc. The postmen's strike some months ago and spasmodic agitation among French "Inscrits maritimes" and school teachers revealed to the public the critical character of a problem that each successive Government has failed to solve. It has become apparent that, if it be not checked, the State will wake up suddenly and find itself face to face with a disciplined army of public servants ready for a general strike. The civil servants of France are not all of this category; but the French Administration is widely affected by the new revolutionary spirit, as is evident from the fact that, in the central committee "for the defense of the right of the wage-earners of the State, the departments, and the communes to form trade unions," are representatives of the naval reserve men, of the municipal laborers, of the State tobacco and match factories, of the School Teachers' Union, the Postmen's Union, the Mint, the prison warders, and the Custom House officers. All these different organizations have decided to reject the Government bill, and "to continue the struggle for the integral application to their case of the law of 1884 on trade unions." They have addressed to M. Clémenceau a document which they call an open letter, and which they have posted up all over Paris. The letter constitutes a challenge to the Government, and is couched in such terms that the *Temps* says of it: "It is impossible to assume a more impertinent and audacious tone."

MUNICIPAL OWNERSHIP CORRUPTION.—Mr. Henry Clay Peters, "municipal ownership" alderman, with two associates, has been indicted by the New York Grand Jury for perjury, etc., in connection with the attempt to buy the election of Judge Cowing as "municipal ownership" recorder, in the last campaign.

TELEGRAPHS IN AFRICA.—The Paris *Temps* states that it has been decided by the Algerian Government to extend the telegraph line which now terminates at Beni-Abbès to Adrar, in the oasis of Touat. The length of this new line is 248 miles, and the cost is set down at from $60,000 to $80,000. When this line has been completed, a further extension to In-Salah is contemplated, with the ultimate object of crossing the desert.

EARTHQUAKE WARNINGS.—According to dispatches from Manila, earthquake experts there believe that it is possible to be warned by wireless telegraph eight or ten hours in advance of shocks. Tests are now in progress as the result of observations during the last tremble. At that time vibrations in the wireless apparatus were noted eight hours before the earthquake was felt. The phenomena can be explained on no other hypothesis.

HALL OF FAME.—A Parisian evening newspaper is conducting a contest among its readers to determine the real celebrities of the world. Dr. Roux, director of the Pasteur Institute, heads the list, followed by Mme. Sarah Bernhardt. But Mr. Edison is a close third, with M. Santos-Dumont fourth, while Mr. Roosevelt is a poor eighth. Mr. Roosevelt and Mr. Edison are the only Americans on the list, which, however, contains no Englishman and, needless to add, no German.

THE LINCOLN SHOW.—The gas and electric exposition held in the Auditorium at Lincoln, Neb., April 22 to 27, under the management of Mr. T. B. Mitchell, of the commercial department of the Lincoln Gas & Electric Light Company, drew out an excellent display of gas and electric appliances for general public use. Mrs. E. O. Hiller gave each afternoon and evening a lecture and demonstration of cooking. Mrs. Hiller was formerly of the Chicago Domestic Science Training School. Many central station men from Nebraska and Iowa went to the exposition and took customers with them to learn how to use the apparatus to the best advantage.

ELECTRICITY IN SPAIN.—Consul-General Ridgely, of Barcelona, Spain, reports that according to recently published statistics there are 1140 generating stations in Spain, with a total annual output of 99,513,170 kilowatt-hours. Madrid has a station capacity of 15,998 kilowatts, and Barcelona follows with 8082 kilowatts. The total number of incandescent lamps in Spain for street lighting is 119,105, with 1,427,498 candle-power, and 1691 arc lamps of 1,214,476 candle-power. For private or domestic use there are 1,593,402 incandescent lamps of 13,333,783 candle-power and 8051 arc lamps of 5,303,777 candle-power. There are also 3293 electric motors with a total capacity of 25,382 horse-power.

DEPOLARIZING PRIMARY BATTERIES.—The use of a primary battery for the storage of energy, under conditions where the polarizing effects are overcome, is disclosed in a patent recently issued to Prof. F. W. Springer. The battery is employed in connection with a small direct-current dynamo in an ignition system for an internal-combustion engine. The dynamo is connected in parallel with the battery and the circuits are so arranged that the dynamo and the battery act together to supply the required current for the ignition. Between sparks the dynamo current passes through the battery in a direction reverse to the direction of the battery discharge current. In this manner the battery is depolarized and refreshed.

OPENING OF THE ILLINOIS TRACTION SYSTEM.—The first section of the alternating-current system of the Illinois Traction System was opened between Peoria and Bloomington April 21. On that date a regular schedule was put into operation, cars leaving the terminal stations on the odd hour throughout the day from 5 a. m. to 11 p. m. Beyond the usual delays incident to warming up new equipment, the single-phase motors and auxiliary apparatus worked well. This road is one of the four single-phase lines in the Middle West which have adopted single-phase alternating-current apparatus made by the General Electric Company. On Sunday, April 28, special rates between the various stations were advertised by circulars, the cost of one round trip from Peoria to Bloomington being fixed at $1.

NEW MEDITERRANEAN CABLE.—U. S. Consul-general B. H. Ridgely, of Barcelona, reports that the Spanish Government has just laid a submarine cable from Barcelona to Palma de Mallorca, in the Balearic Islands. The cable was put down by a London company, and is 117 miles long, the cable ship laying it in less than two days. The contract price for the cable laid was $145,995, which will be paid by the Spanish Government. This line has long been required for commercial purposes, and the Government yielded to the urgent demand of the united business elements of Barcelona and Palma de Mallorca. Barcelona is the great commercial metropolis of Spain, with a population of about 700,000, and Palma de Mallorca is the principal city of the Balearic Islands, with a population of about 70,000, and is the seat of considerable industry. Heretofore the only cable line connecting the Balearic Islands and the Spanish Peninsula was the one from Valencia to Palma, but this was not sufficient for the commercial necessities of Barcelona. The Spanish Government has two other cable lines leaving the Peninsula, one from Cadiz to Teneriffe, Canary Islands, the other from Cadiz to Tangier. Two English companies own all the other cable lines leaving Spain. These are the lines from Barcelona to Marseilles, France, and from Bilboa to Falmouth, England; also lines from Cadiz to Port Cornaw, Cornwall; from Vigo to Port Cornaw, and from Vigo to Lisbon. In the new cable from Barcelona to Palma there are six copper wires; the system of receiving and transmitting is the Morse.

FRENCH TELEPHONY.—It is stated that after three years' of complaint and agitation against the telephone service supplied in Paris the system, which is owned and operated by the French Government, the Association of Telephone Subscribers has at last secured a prospect of reform. Government ownership, according to this association, has given to the public far worse equipment and operation than is the case in cities where the telephone business is run by a corporation. The Association of Telephone Subscribers was formed three years ago to protest against the neglect of the telephonic needs of the city and to bring sufficient pressure to bear on the Government to bring about reform. The technical side of the business was studied and the committee came to the conclusion that the plant must be improved and enlarged, and that it would be well to copy the common battery system. No attention was paid to these suggestions at first, and last year a petition signed by more than 32,000 telephone users was presented to the French Chamber of Deputies. The petition complained of all features of the Government's telephone administration, declared the service inefficient, the rates too high and the rules and regulations arbitrary and complicated. As a result of this agitation the Government is now about to put in service 300 new trunks between the central exchanges, and thirteen new central offices, each of about 10,000 lines capacity, are to be constructed. With the new exchanges the system will have a total capacity of 200,000 lines. It has also admitted that the rates are too high and a readjustment is under discussion. Two other reforms urged by the committee are also to be adopted. A training school for operators is to be organized and a special staff of inspectors is to be appointed.

Tyrol Hydro-Electric Power Station, Keiserwerke.

BY FRANZ KOESTER.

TO supply electric power for industrial and lighting purposes in the interurban districts between Kufstein and Kundl, in the northern part of Tyrol, the waters of the Hintersteiner Lake have been utilized in a power plant on the River Weissacher-Ache. The lake lies 2900 ft. above the Adriatic Sea level, and the net head available at the power plant is 1053 ft. The maximum capacity of the plant is 1284 horsepower, but should occasion arise several subsidiary streams could be turned into the lake raising the maximum capacity, under the most unfavorable conditions, to 3000 hp. To collect the water which previously ran down the mountain slope a concrete dam was constructed across Weildback River, and after passing a rack (to prevent the passage of fish and crabs for which this lake is famous) the water enters the supply tunnel. In this tunnel a sluice gate is provided. The tunnel has a width of 3.3 ft., a height of 3.8 ft. and a length of 968 ft. This joins another section of tunnel of a length of 3529 ft. and a cross-section of 1.4 ft. by 6.5 ft. high. This latter had to be blasted through dolomite, for which purpose, on each side of the tunnel, a small power plant was installed in order to supply by benzine motors electric power for drilling. Each of these plants was equipped with an 8-hp direct-current 150-volt motor, while a small motor operated a fan for ventilation during construction and also a water pump. The motors for drilling machines were of 3-hp capacity. On account of the small cross-section of these tunnels only one machine could operate at a time, hence the reason for the small size of drilling tools, with which only 5.4 ft. could be completed in 24 hours. A third section similar to the first was also installed with an arched roof and inverted arch bottom. The first and third sections were lined with masonry; the center one, however, needed no lining as it was drilled through solid rock.

The water before entering the penstock is led into a collecting basin provided with a fine screen. At the side of this basin is an overflow leading the surplus water down the mountain side into the Weildback.

The penstock has a diameter of about 2 ft., which in the development of 1300 hp would mean a velocity of 50 ins. per second, which would mean a drop in head of 6.5 ft. due to friction. With the further complete installation (3000 hp) the velocity in the penstock would be 9.8 ft. per second, entailing a drop in head of 32.8 ft. on account of friction. The part of the penstock having the collecting basin is of cast iron imbedded in the concrete of the basin. The total length of the penstock is 2349 ft., running down the mountain slope and following the lines of the ground with a number of bends. The steepest section is at the middle of the penstock and has a slope of about 45 degrees. There is a total of 11 sections, the thickness of material varying with the pressure; the five upper sections have a thickness of from ¼-in. to ⅜-in. and are made up of rolled steel plates, with the longitudinal lap single-riveted and the section laps double-riveted and provided with cast-steel flanges. These sections are made up of 19.7 ft. pipe lengths. The lower end of the penstock is made up of welded steel pipe of from ⅜ in. to ⅝ in. thickness, and have a length of 29.5 ft. In the upper sections the flanges were riveted on, but in these lower sections they are welded on. The entire length of the riveted pipe is 1220 ft., while that of the welded pipe is 1066 ft. The upper riveted section has been calculated for a pressure of 14,700 lbs. per square inch, with an allowance of 3/32-in. for rusting, while the lower section is calculated for a pressure of 12,900 lbs. per square inch with an allowance of 1/16-in. for rusting.

As the penstock follows closely the lines of the mountain

FIG. 1.—VIEW OF INTERIOR OF GENERATING ROOM.

slope a number of elbows were necessary. The expansion is taken care of by expansion joints of the stuffing-box type, which in some cases are placed at both sides of an elbow. The entire penstock is not anchored to the ground, but rests on saddles (Fig. 2). some of which are low concrete piers, and others high latticed steel frames, hinged at the bottom in a concrete base to allow longitudinal expansion and contraction of the penstock; still others at the elbows are made of very heavy steel castings anchored to concrete piers. The penstock terminates in a trench alongside of the power house, whence branches run direct to the turbines. There are at present four branches, two for the main unit and two for the exciter unit. The end of the penstock is provided with two safety valves.

The power plant is erected at the side of the River Weissacher-Ache. A heavy concrete retaining wall had to be erected for protection from high water, which also acts as a foundation for one of the power plant walls. The plant itself is built of locally quarried stone and is designed for the accommodation of

FIG. 2.—PENSTOCK AND HINGED STEEL FRAME SADDLES.

three main units and two exciter units. The clear length of the power house is 90 ft. and the width 33 ft., with an end partition cutting off a two-story switching room. The switchboard is 8.5 ft. above the generating room floor over a repair shop and storeroom. The plant is equipped with a 7½-ton hand-operated traveling crane.

There are at present two main units installed, each of 1200 hp capacity and two exciter units (Fig. 3) of 60 hp each. The large capacity of the exciter units is due to the fact that power is taken from them for lighting the building.

The turbines are designed for a net head of 1025 ft. and at 480 r. p. m. develop 1200 hp. The full-load efficiency was guaranteed at 80 per cent. The turbine is of the Pelton type and the runner is provided with interchangeable buckets. The casing is of cast iron, while the smaller parts are made of bronze. The regulating mechanism of the turbine set is sensitive and operates on a hydraulic auxiliary motor and oil brake. This governing mechanism allows a variation of 5 per cent from full-load to no-load and 3 per cent from three-quarter load to no-load. Provision is made to throw the turbogenerators in parallel from the switchboard. To insure satisfactory parallel operation, heavy flywheels are provided.

The exciter turbines are designed for 1025 ft. head and at 800 r. p. m. develop 60 hp. The governing devices on these turbines are similar to those on the main units. The large and small turbines are connected to the generator-shaft by means of flexible insulated couplings, system Ruesch. The main gen-

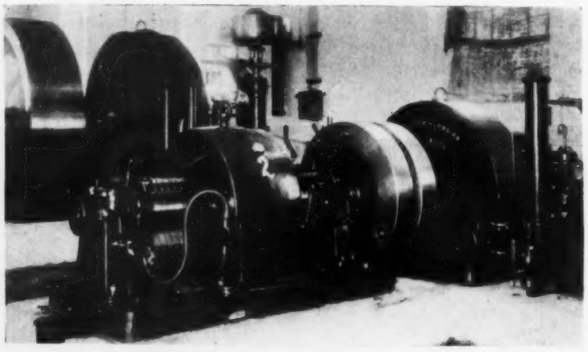


FIG. 3.—EXCITER UNITS.

erators at the above speed produce 1080 kilovolt amperes, three-phase, at 40 cycles. They are of the revolving-field type with 10 poles. The excitation power at full-load with unity power factor is 16 kw. The efficiencies at various loads at unity power factor are as follows: Full load, 96.2 per cent; three-quarter load, 95.5 per cent; one-half load, 94.2. The figures for a power factor of .75 are respectively 94.2, 93.5 and 92.6 per cent.

The exciters, one of which is in reserve, are of the four-pole type, and feed to two bus-bar systems, while the main generators deliver to a ring-bus system. Between the generators are the outgoing feeders; sectional switches are placed in the bus-bars. Mechanically operated high-tension oil switches are used. On the switchboard (Fig. 5) are the requisite apparatus for throwing the units into multiple. As in many power plants in mountainous districts, special devices are employed to protect the plant from atmospheric discharges. These consist in the present case of Gola and horn lightning arresters and over-

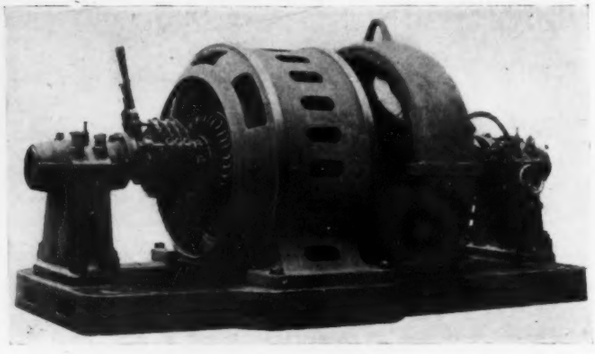


FIG. 4.—MOTOR-GENERATOR OF SPECIAL DESIGN.

load fuses. In connection with these devices streams of water are played on the wires to carry off any excessive potential.

The switchboard is divided into nine panels, of which three serve for the main generators, two for the exciters, three for the outgoing feeders and one for the ground detectors and transformers. Each generator panel has mounted on it a voltmeter, ammeter, wattmeter, a high-tension cut-out switch, a phase lamp, and a double-throw switch for the regulator motor. There is also a double-pole cut-out switch for the exciter, a main-current regulator and an exciter-current ammeter. With

these instruments it is easy to govern the operation of the entire station from one of these three panels. Each exciter panel has a shunt-wound regulator, a voltmeter and a double-pole switch for each generator field circuit. Each of the three feeder panels contains the necessary meters and the high-tension cut-out switches. The last panel contains three voltmeters connected in star with the neutral connected to the ground, and also the switches for the transformer buses. The panels are of white marble mounted on a skeleton steel frame. All high-tension apparatus is mounted back of the board.

There are two outgoing feeders leading from the end of the power station, provision, however, being made for four additional ones. These are carried on triple-petticoat porcelain insulators, mounted on wooden poles above the telephone system. All of these poles are provided with tin caps to protect them from the weather, and to protect them from lightning a horn lightning arrester is placed in each phase.

At the center of distribution the voltage is reduced from 10,000 to 2000. There are three sub-stations for general distribution and one for a cement manufacturer. Each has a capacity of 350 kilovolt-amperes, the transformers being 8.8 ft. high, 10 ft. long and 2.3 ft. wide, and on account of the height are placed in pits. They are of the water-cooled oil type and at full-load have an efficiency of 97.6 per cent. Current at 10,000 volts enters the sub-station from a tower at the top, passes through oil switches to the transformers and thence through secondary oil switches to the distributing system at 2000 volts.

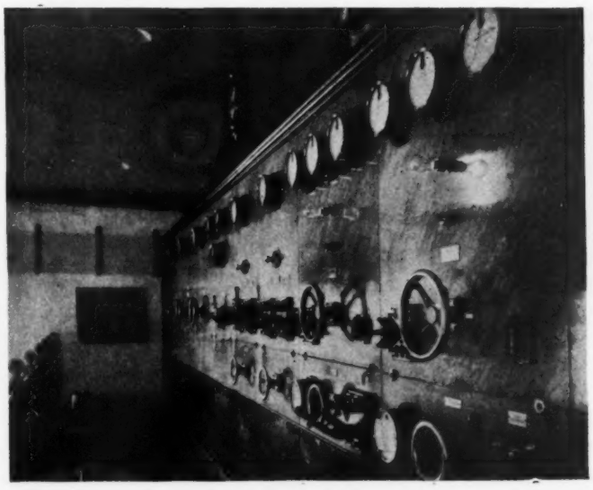


FIG. 5.—SWITCHBOARD.

The sub-stations are well equipped with the necessary instruments and lightning arresters.

One of these sub-stations is used as an auxiliary for the Woergl hydraulic power plant and is, therefore, equipped with a special type of motor generator (Fig. 4). The 10,000-volt current is transformed down to 350 volts by an 80-kw transformer, at which potential it drives the above-mentioned motor generator, 150-300 volts (three-wire system) direct current being taken from the generator. The motor has a capacity of 100 hp, that of the generator being 75 kw. The field-winding of the synchronous motor is switched in cascade with the armature-winding of the generator.

Between the generating station and the sub-stations there are connected into the line several transformer stations. The buildings are designed with a height of 17 ft. in order that the lines may be run straight through. These are for the purpose of supplying small consumers along the line.

The turbines were manufactured by the Turbinenbauenstalt Ruesch at Dombirn, Switzerland, while the entire electrical equipment was designed and installed by the Elektrizitaets Aktien Gesellschaft, vormals Kolben & Company, of Prague, Bohemia.

A New Variable Speed Motor.

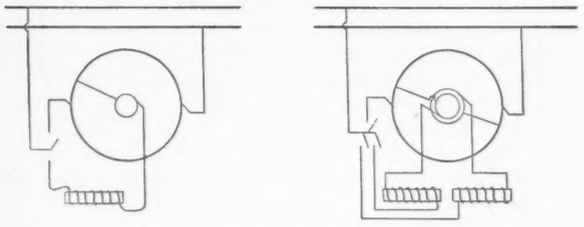
By Benj. F. Bailey.

A SHUNT-MOTOR giving a speed range of, say, four to one by field control can be readily enough produced, but the cost is prohibitive to the average customer. The extra cost is attributable largely to the tendency to spark at the higher speeds when the ordinary design is used. To overcome the sparking it becomes, in general, necessary to use a much larger motor than considerations of heating alone would require. If a motor can be arranged for two or more normal speeds; that is, two or more speeds for each value of the field current, the sparking may be reduced. Two normal speeds may be obtained either by the use of two commutators and two separate armature windings, or by varying the impressed voltage. The latter involves the use of a three-wire generator or a multiple-voltage system of some sort.

There is given below a description of a very simple method devised by the writer, by which either all or one-half of the armature conductors can be connected in circuit, thus giving two normal speeds, one twice as great as the other. The method requires only an ordinary motor, normal in all respects except that one or more slip rings are mounted on the shaft and connected to the proper points on the armature winding, exactly as though the machine were to be used as a rotary converter. One or more inductive reactance coils are connected with the rings. The reactance coils can be used in a great variety of ways, a few of which are shown in Figs. 1, 2, 3 and 4. In the illustrations the coils are shown as though the magnetic circuit were open, merely for the sake of clearness, but in practice closed magnetic circuits would be preferable. It is also evident that the coils might be mounted on the armature structure and revolve with it, in which case only one slip ring would be needed.

The equipment utilizes a standard design of motor and requires only very slight changes in patterns and drawings.

The operation of the motor will perhaps be best understood from Fig. 5, which corresponds with the connection shown in



FIGS. 1 AND 2.—VARIABLE-SPEED MOTOR CONNECTIONS.

Fig. 4. With the switch *S* closed on the upper contact, the machine operates as a simple shunt motor. A small alternating magnetizing current flows through the inductance. The slight loss of power thus produced can be avoided by using a double-throw switch, single-pole on one side and double-pole on the other, as shown in Fig. 4. Variations in speed from normal to double normal may be obtained in the usual way by means of the field rheostat *R*.

With *S* closed on the lower contact, however, the motor runs at twice its former speed and by weakening the field the speed may be increased to, say, four times its lowest value.

When operating in this way only one commutator brush is in use, and the other may be removed from the commutator without affecting the operation in any way. The current in the main leads is a non-fluctuating direct-current. In the inductance itself there is a small alternating magnetizing current superimposed upon the direct current. Considering the two branches into which the direct current divides, it will be seen that in general in any one of them the current is flowing against the e. m. f., and is thus imparting energy to the magnetic field of the inductance coil. This energy is, however, being used as fast as generated to force current through the other half of the induct-

ance coil in the opposite direction. The ends are always at just the same potential as the points of the armature to which they are connected. The potential of one end of the inductance coil is lower, and that of the other is higher than the middle or feeding point.

After reaching the commutator, the two currents flow to the one brush and so out. Practically all of the current is confined to one-half of the armature.

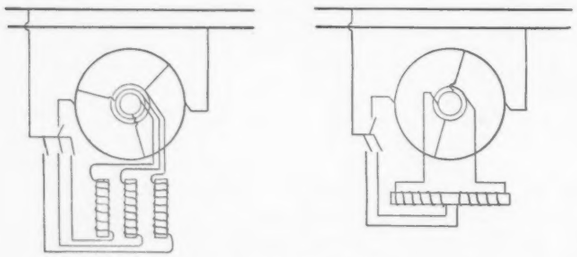
To understand why the motor runs at double speed with this connection, consider a position of the armature such that one slip ring is connected to an armature conductor, which in turn, is directly connected through the commutator to the brush. Half of the current will take this path and will do no work on the motor. Its power, however, is expended in raising the voltage of the other half of the current, so that there results in the armature half the current at twice the voltage.

At a position of 45 electrical space degrees from the first one, one current passes through a quarter of the windings and about 30 per cent of its power at the instant is being absorbed by the motor, the other 70 per cent is being used to raise the pressure of the other half of the current. At 90 electrical space degrees from the first position there is no transformer action and half of the winding is being fed at the line voltage. The pressure supplied to the armature is then just slightly greater than the counter e. m. f. generated by the windings from the point supplied to the brush, and since this pressure rises and falls from zero to double the supply voltage, the effect is equivalent to supplying the motor with half the current at double the voltage.

When connected as shown in the diagrams of Figs. 1, 2 and 3, the action is slightly different. The inductance coils then act as magnetic springs, storing up energy during one-half revolution and restoring it during the other half. The net result is the same, so far as the speed is concerned, but there is some fluctuation of the current during each revolution, and the losses are somewhat greater.

For a motor whose speed must frequently be changed, all of the operations could be performed by one controller handle. The sequence in passing from rest to highest speed would be as follows: Closing of switch S upward, cutting out of starting resistance, insertion of field circuit resistance, opening of S, immediately followed by cutting out of field circuit resistance, insertion of the buffer resistance in the armature circuit and closing of S downwards, cutting out of buffer resistance and increase of field circuit resistance.

The tendency to spark will be no greater at the high than at the low speed. This is readily seen, as the current will be the same for the same power, and the use of the inductance coil has no effect upon the distribution of current at the active brush. However, when the motor is overloaded the sparking that does take place will be confined to one brush, and hence will be only half as injurious as in the ordinary type of motor. In several



FIGS. 3 AND 4.—VARIABLE-SPEED MOTOR CONNECTIONS.

careful tests of a motor operated in this way, no difference could be detected between the currents at which sparking appeared at high and at low speeds.

The I^2R loss, and consequently the temperature rise, is less with the high-speed connection than with the low. It will be noted that with the connection as shown, since current flows in half of the armature coils, the I^2R loss will be half that of an ordinary motor. With four taps into the armature using two inductance coils, one-quarter of the armature will carry practically no current, two-quarters will each have one-quarter of the total current, and the remaining quarter will carry half the current. Hence the I^2R loss will be $[(\frac{1}{2})^2 + (\frac{1}{4})^2 \times 2R = \frac{3}{8}I^2R$, or three-eighths of the normal loss. The loss with three rings is about eleven-twenty-sevenths of the normal, and a simple integration shows that with an infinite number of taps, the heating is one-third of the normal. In these calculations it is assumed that one section carries no current. A small portion of the current would undoubtedly take this path, the result being that the I^2R loss is somewhat less than that stated above.

Conversely, a two-ring variable-speed motor will carry with the same heating, 41 per cent more load at high than at low

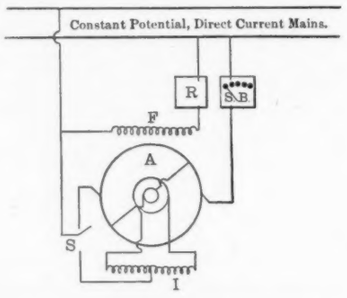


FIG. 5.—SCHEME OF CONNECTIONS.

speed; a three-ring motor 56 per cent more; a four-ring motor, 63 per cent more, and one with an infinite number of rings, 73 per cent more. In practice, either two, three or four rings, according to the size of the motor, would probably be preferable.

At first sight it might appear that the motor has dead points or points of no starting torque. Such would be the case for only one ring, but not for two or more. However, in positions where the current has a direct path without going through the winding, the starting torque is somewhat less per ampere than the running torque. In practice, the lessened starting torque would not be a determining factor since the motor would always be started with the slow speed connections, as previously described.

At slow speed, the efficiency would obviously be the same as that for an ordinary motor, except for the negligible friction of the brushes on the rings. At high speed, the armature I^2R loss would be less, and the decrease would about offset the losses in the inductance. The hysteresis and eddy current losses would, of course, be greater at high speeds, and the efficiency would be slightly less at high than at low speeds.

In the above, it has been assumed that the field winding is of the shunt type. It is evident, however, that any type of winding may be employed. Thus for a hoisting motor a series winding might be employed with an inductance to give two operating speed connections. It is also evident that the device, at least in the form shown in Fig. 4, may be applied to any alternating-current commutator type of motor.

In the ordinary shunt motor using field control, it is necessary if any great range of speed be desired, that the machine have a very large and powerful field in order that sparking may be avoided at the higher speeds. At best, the load capacity at high speeds is much less than at low ones. For instance, a motor capable of developing 10-hp at 400 r. p. m. might be limited by sparking to, say, 7-hp at 800 r. p. m. Equipped with slip rings and inductances in the way indicated above, it would develop from 14 to 17 horse-power. For momentary overload, where the load would be limited by sparking, the maximum horse-power would be the same at high as at low speeds. A motor capable of giving a range of speed from 1 to 1.8 by field control could, when connected as indicated, give a range of 1 to 3.6. Compared with a plain shunt motor of similar range, it would be much cheaper to build, more efficient in operation, and better able to withstand overload at high speed. If full load capacity be not absolutely required at low speeds, the cost could be still further reduced.

Electric Tugs at Niagara Falls.

One of the most serious problems of the several power developments located at Niagara Falls has been the handling of ice during the winter months. Not only is the normal formation of ice in the river serious, but under certain wind conditions in the Great Lakes large floes of ice are discharged from Lake Erie into the head of the Niagara River completely filling the river from shore to shore.

When the plant of the Niagara Falls Power Company was first started, there was no similar installation of its kind in the world, and consequently there was no previous experience from which the engineers could draw for guidance in determining just what conditions could be expected in drawing water in considerable quantity from a comparatively shallow, but wide, river under severe ice conditions. The intake canal was set at an angle slightly less than 90 deg. with the up-stream bank of the river. With this arrangement, it was thought that floating ice would be deflected by, instead of into, the canal entrance. As a further protection, log booms composed of a

ELECTRIC TUG.

series of floating logs were placed across the mouth of the canal.

The above methods proved partially effective, but as the output of the plant, and consequently the volume of water entering the canal, increased, large amounts of ice were drawn into its entrance. This ice, if allowed to pass into the penstocks, tends to clog the turbines, causing loss in efficiency and output, or even serious damage. To dispose of the ice entering the canal, a vertical shaft was sunk at its far end, emptying into the discharge tunnel from the wheel pit. As this shaft is necessarily located beyond the intakes to the penstocks, there is no draft of water toward it except that which is produced by the small amount of water allowed to pass through the sluiceway leading to the head of the shaft. Some additional means was therefore found necessary to propel the floating ice towards this sluiceway, as otherwise the ice accumulates, and builds up in the lower end of the canal.

It has been found that a tug boat is the most efficient and economical method of accomplishing the desired result. When moored with the propeller running at full speed, a large surface current of water is set in motion from the stern of the boat. By varying the length of the mooring cable, or by changing the point of mooring, this current of water can be directed from any point in the canal so as to effectively propel all floating ice towards the ice sluiceway. When not moored the tug boat can be used to break up, and stir up any unusual accumulation of ice tending to block the intake canal.

For several years, steam tugs were employed for this purpose by The Niagara Falls Power Company, but as the work is only intermittent, it was felt that an electric tug would be more economical on account of lower operating expenses. With steam tugs, the Government regulations require the steady employment of a pilot, engineer and fireman, and the nature of the work necessitated the keeping up of steam constantly, as the tug might be called for on a moment's notice. The area within which the tug had to operate was small so there was no physical limitation to prevent the use of an electric tug supplied with energy from the power house through an overhead trolley and cable.

Two years ago, The Niagara Falls Power Company installed in its intake canal on the American side of the river a small experimental electric tug to supplement the work of a steam tug. This tug which is still in service is 25 ft. long by 8 ft. beam by 4 ft. draft, with a propeller 52 in. in diameter by 2 ft. pitch. It is supplied with power through an overhead trolley 750 ft. long composed of two 2-0 copper wires, 2 ft. apart, suspended about 35 ft. above the water, running lengthwise down the middle of the canal. The aluminum trolley carriage which travels on these wires is of special construction designed by the power company's engineers.

From the carriage a 2-0 duplex flexible rubber and braid cable leads direct to the motor controller through a hollow mast over the pilot house of the boat itself, the top of the mast being about 15 ft. from the surface of the water. The cable has sufficient slack to allow the tug to operate at either side of the canal, thereby giving an effective area of work the full width of the canal and the full length of the overhead trolley wires.

The electric equipment in the boat consists of one 75-hp, single-phase, 220-volt, 25-cycle motor of the standard railway type with drum controller and grid resistances. The motor is geared to an extension of the propeller shaft through a single pinion and gear having a ratio of 16 to 66. This reduction gives about 240 r. p. m. to the propellor shaft with the full load speed of 1000 r. p. m. in the motor armature.

The results obtained by this tug boat have been very satisfactory. It is available for service on a moment's notice, and is easily handled by one man, who, when the boat is not running, can be employed on other work about the power house. There are, therefore, no operating exepnses except when the boat is actually in service.

The success of this trial boat has led to the construction of a second and larger tug boat which was installed last fall in the forebay of the Canadian Niagara Power Company. The latter boat is of sufficient capacity to handle all the work at the Canadian plant, and is not supplemented by a steam tug. The boat operates along the outer wall of the power house, and its function is to prevent any large accumulation of floating ice, which if it were allowed to form, would finally be drawn through the submerged arches in the outer wall, and hence into the penstocks and the turbines.

By means of the surface current which it sets in motion, the boat propels all floating ice towards a spillway canal at the lower down stream corner of the outer wall of the power house, the spillway canal returning the ice to the river some distance below the entrance of the main intake canal. The Canadian tug boat is 40 ft. long by 10 ft. beam by 6 ft. draft, and its propeller is 4 ft. 4 in. in diameter by 2 ft. pitch. The trolley wires are two 2-0 copper wires, two feet apart, and run parallel with the outer wall of the power house for the full length of the forebay, a distance of about 600 ft. They are suspended from two steel trolley poles 60 ft. high located at the two opposite ends of the forebay. This height gives a wide range of operation with but little slack in the cable leading from the trolley carriage to the boat.

The trolley wires are secured through strain insulators, and the current at an e. m. f. of 1100 volts is conducted to them

by a duplex 3-0 lead sheathed cable which is lead up one of the guy rods of the lower trolley pole. The trolley carriage is made of aluminum to reduce its weight, and is similar in design to that used in the American equipment. From the trolley carriage a duplex flexible rubber and braid cable leads to the boat.

The electric equipment on the boat consists of one 125-kw, air-blast transformer and two 75-hp, single-phase railway motors of the same type as installed in the tug of The Niagara Falls Power Company. Several low voltage leads are brought from the secondary of the transformer giving a range of e. m. f. from 56 to 220 volts with 1100 volts impressed on the primary. This range of voltage is used in bringing the motors up to full speed or in running at reduced speed. A single controller of the drum type, in connection with the low-voltage leads mentioned and with a preventative resistance and impedance coil for each motor, operates both motors. The two motors work in parallel, and each is geared direct to the 6-in. propeller shaft through a pinion and gear having a ratio of 16 to 66. This gives the same propeller speed as in the American boat, although the Canadian boat is much more powerful, developing a total of 150 horse-power.

The power for operating the tug is supplied from the main switchboard at 11,000 volts, which is reduced to 1100 volts through a 125-kw water-cooled transformer located in one of the sub-floor chambers of the power house. At this voltage the power is distributed to the trolley system as outlined above. Suitable meters, switches and circuit breakers are installed in the 11,000-volt circuit for the purpose of controlling and measuring the power used by the equipment.

In both the American and Canadian boats it is necessary to use air blast for cooling the motors and other electrical equipment, as the hull of the boat offers very little opportunity for the radiation necessary if self-cooled electrical apparatus were used. In the Canadian tug boat forced draft is supplied by a 1-hp alternating-current series motor, direct connected to a blower. Air pipes with suitable dampers for properly regulating the flow of air lead from the blower to the motors and transformer cases. The suction side of the blower is connected to the outside air. In this manner cold air is forced through the portion of the motors and transformers near the windings.

The hulls for both the American and Canadian boats were built on the ground by Benjamin L. Cowles, of Buffalo, N. Y., and are very solidly constructed of oak to prevent any possible damage by ice. Westinghouse apparatus was used for the entire electrical equipment of both installations. The general design of the equipment, installation of the machinery in the boats, and the overhead trolley construction were carried out by the power company's engineers.

Discussion of Electric Heating at the Iowa Convention.

At the convention of the Iowa Electrical Association at Clinton, April 18 and 19, a considerable portion of one session was given over to the discussion of electric heating devices. A paper was read by Mr. E. L. Callahan, of the General Electric Company, on "Increasing the Central-Station Day Load," which was followed by the experiences of several Iowa central-station men.

Mr. O. K. Cole, of Grinnell, was called upon, as his company has made a good start in the introduction of electric heating devices. Mr. Cole said the experience of his company had been very satisfactory with this class of business. As a general policy he would solicit first the introduction of the smaller units, such as the coffee-percolator, chafing dish and waffle-iron. These three devices operated electrically produced results which could not be obtained with any other method of heating, since they could be used on the breakfast table. He was especially enthusiastic over the waffle-iron, as the cooking of waffles could be done on the electric irons with an exactness that could not be obtained with any other iron because of the uncertainty of heat in irons heated with gas or coal. With the electric iron it was only a question of leaving them in a certain length of time. In towns under 5000 the introduction of such devices must be mainly by the personal, individual effort of the manager in taking up the question with such possible customers as he knew were most progressive and who would be willing to pay for superior results in cooking rather than to look simply at the cost of operation.

Mr. Callahan pointed out that it is out of the question to attempt to do much heavy electric cooking work unless the rate is 6 cents per kw-hour or lower. Mr. Austin Burt, of Waterloo, in order to provoke discussion, submitted the proposition that the heating field rightfully belongs to gas and that in order to compete with gas the electric rates must be so low as to be unprofitable.

Mr. J. R. Cravath said that electric cooking had a certain field of its own which could not be claimed either by gas or coal. For example, as Mr. Cole, of Grinnell, had pointed out, a certain amount of electric cooking could be done on the dining-room table, which put it in a position where no other common method could compete. This was a great convenience, especially at breakfast. There were many central stations operating day circuits in towns which were too small to support a profitable gas plant. In such towns electricity, on account of its convenience and safety, could certainly be introduced against the competition of gasoline and coal stoves; so taken all together, there are many places where gas does not enter into the consideration at all.

Dr. L. D. Mathes, general manager of the Union Electric Company of Dubuque, gave a very interesting extended talk on the efforts of his company to arouse interest in electric cooking. He said that his company had spent more than any other Iowa company to arouse the interest of the community in this. He then described a series of lectures and demonstrations given at Dubuque under the auspices of the "Household Economics Division" of the Dubuque Women's Club. This lasted about fifteen days and was supported financially by the Union Electric Company, at a cost of between $1,500 and $1,800 the name of the company not appearing however, in connection with the enterprise, although it furnished the rooms and current for the electric cooking devices which were used successively by the lecturers and demonstrators. The lecturers and demonstrators included Mrs. F. Violet Sanborn, of St. Louis; Miss Rasch, head of the domestic science department, Iowa State College, Ames; Miss Nan Martin, demonstrator for the General Electric Company; Prof. Maurice Le Bosquet, of the American School of Household Economics; Prof. Oldt, superintendent of the Dubuque public schools and five demonstrators on duty at various hours. A model cottage was built in the room where the demonstrations were given and was fitted up with all the electrical conveniences.

The feat was performed every day of doing a moderate-sized washing and ironing and having the clothes dry in three hours. The washing was done in a motor-driven washing machine, the motor also operating the wringer. The clothes-drier was warmed by a common 12-inch desk fan blowing air through the coils of some electric car heaters. The ironing was, of course, done electrically. A standing challenge was out to anyone to do the same washing, drying and ironing in the same length of time in their own households, using the ordinary methods. They had found the cost of motor-driven washing machines to stand somewhat in the way of their introduction. By contributing the work of installation and the power, this company could furnish a motor-driven washing machine for $50.50, which looked large to a person accustomed to paying a much smaller amount for a hand-driven washing machine.

He considered the development of the electric heating business one of the greatest fields of the central station. The electric iron especially had been one of the best things ever devised. As to the success obtained in the introduction of these devices, much would depend on the judgment of the central station manager. He thought it best to start first with the smallest devices and gradually work up to complete cooking outfits.

Electric Refrigeration at Thompson's Spa, Boston.

An unusually complete electric refrigerating plant operated on central station service is that of Thompson's Spa in Boston, located at 219 Washington Street. The establishment purchases electricity from the Edison Electric Illuminating Company of Boston for a large variety of lighting, heating and small power purposes. The refrigeration requirements are of an exacting character in view of the limited space available for such machinery, the necessity of absolutely clean methods of cooling and the extensive use of artificial cold in the four buildings which the restaurant occupies. Thompson's Spa has no steam plant, as the boilers of Young's Hotel, located close by, are available for such service. A motor-driven plant, therefore, offered the most attractive solution of the refrigerating question under the prevailing conditions.

Two refrigerating layouts are at present in service on the premises. The first installation used by the Spa is located on the third floor, and it consists of a 1-ton Brunswick compressor and direct ammonia expansion system used to cool twelve small refrigerating chests, one large and two medium sized refrigerators. Openings are provided between different refrigerators to permit an even distribution of the cooling effect. This equipment is operated by a 2.5-hp Sprague shunt-wound motor of the direct-current, 220-volt type. The motor frame is of the 10-hp size, to permit of the low speed of 218 r. p. m. for direct coupling to the compressor. The expansion coils in this system are located in the refrigerators so that the ammonia is piped directly to the points to be cooled. The temperature requirements vary in general between 32 and 42 deg. F., and as the service is carried on without the use of brine, its area of distribution is more limited than that of the second and larger installation. The smaller plant usually operates about 14 hours per day.

The larger plant is located on the second floor, just below the first installation, and it consists at present of three 4-ton machines and auxiliary equipment supplied by the Brunswick Refrigerating Company of New Brunswick, N. J. Space is

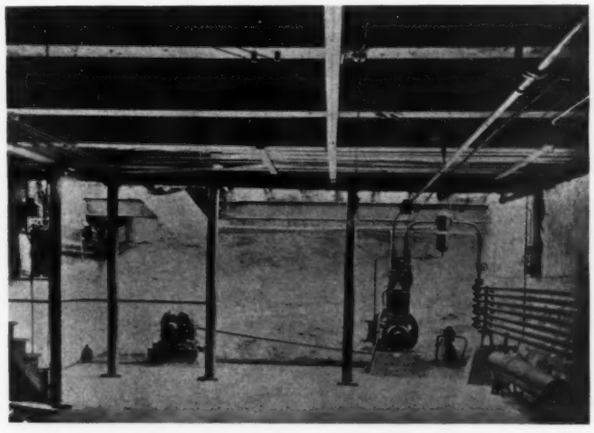


FIG. 1.—GENERAL VIEW OF REFRIGERATING PLANT.

provided for the installation of a fourth unit of the same capacity when it is needed. Two of the machines are located on diagonal axes at the main second-floor level. The third outfit is mounted on a raised platform at one end of the room, which is about 40 ft. by 16 ft. over all. On the original floor level is installed a brine tank 18 ft. by 5 ft. by 6 ft., capacity 4000 gals., and a 12-ton brine cooler, of the Hendricks type, supplied by the Carbondale Machine Company, is located on the raised section. Two ammonia receivers are provided for this equipment on the wall of the original room where the first two units are installed. The piping is flexibly arranged, providing for the expansion of ammonia into coils in both the brine tank and brine cooler as desired. The condensers, two in number, 15 ft. long and 6 ft. high, are located on the third floor. These are of the inner tube type with water on the inside and ammonia outside.

The compressor valves in this installation are a radical departure from the old style conventional types. The vertical type economizes space; the suction valve is carried on the inside of the discharge valve and has its seat on the face of the latter. This enables the suction valve to be of large diameter, preventing excessive lift, and the discharge valve is made the full diameter of the cylinder, requiring no clearance. This prevents in large measure any rushing of the compressed gas

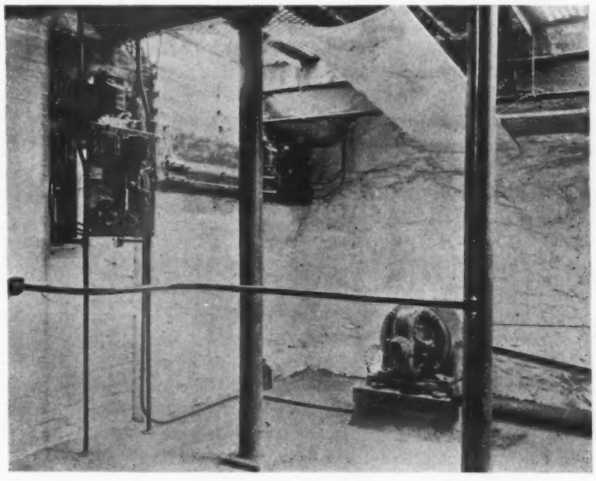


FIG. 2.—MOTOR OF REFRIGERATING PLANT.

back into the cylinder on the suction stroke before the discharge valve closes. The location of the suction valve seat on the face of the discharge valve also obviates any sticking of the discharge valve. Calcium chloride brine is used in this installation.

Each compressor is direct-driven on the same shaft by a 10-hp (in 40-hp frame to secure low speed) 220-volt Sprague motor, shunt-wound, direct-current type, normal speed 175 r. p. m. There are two International volute pumps installed on a steel platform above the main brine tank for forcing the brine through the piping in the various buildings. Each of these pumps is direct-driven by a 220-volt, 5-hp Sprague motor, normal speed 1300 r. p. m., and has a capacity of 120 gals. per minute against a load corresponding to 30 lbs. per sq. in. All the compressor motors and these pumps are controlled from a single switchboard panel located near the main compressors. A specially metered circuit of the Boston Edison Company with watt-hour meter and Wright demand indicator is installed for the refrigerating plants. The brine circulation piping includes a bypassed Worthington low-pressure meter near the cooler so that the rate of flow can be measured whenever it is desirable. The incoming and outgoing brine differ in temperature as a rule by from 2 to 4.5 deg. All the wiring in the plant is installed in armored conduit.

The uses of the larger plant include a large number of applications at the lunch counters, in ice chests and in water cooling. At present the Spa uses but about 1 ton of ice per day, and it is likely that this consumption will be reduced further. A new soda fountain is supplied with water cooled to about 32 deg. F., and the original fountain still in service will soon be equipped with cold water circulation instead of using ice. All the counters are provided with this circulation of cold water, which is pumped from a 3400 gal. tank located beneath the basement floor. Duplicate centrifugal pumps of the Douglass type are provided for this service, and the motors are 3-hp, 220-volt Sprague direct-connected machines. This tank is cooled to approximately a freezing temperature. Ice cream is always frozen by the agency of the brine.

circulation; and the heaviest load upon the refrigerating plant usually occurs in the forenoon, when the ice cream production takes place.

The large plant operates continuously including nights, Sundays and holidays. One machine is always in service, a second unit is operated as needed, and the third is at present kept as a spare outfit. It is probable that in the coming summer all the machines will be operated at times of heavy peak load, when the temperature approaches 90 deg., with excessive humidity. The brine circulation is thus continuous. To prevent the accumulation of frost and dirt in the large ice chest in the basement where mineral water, etc., are kept at about 38 deg. F., a double set of brine coils is installed, the coils being alternated in use each day. The cold water circulation usually runs mainly in the daytime, from 6 a. m. to 11:15 p. m. Recording and indicating thermometers are liberally installed. The average load during 12 hours of the day at present is about 82 amperes at 220 volts on the refrigerating system, and 38 amperes at night. The avoidance of the inconveniences due to the handling of a large quantity of ice is a particularly strong point in this compact installation.

Commutating Poles in Direct-Current Machinery.

The general features of commutating poles and their advantages when used with variable-speed shunt-wound motors have been discussed from time to time in our columns, and are well known to our readers. The principal advantage resides in the fact that the commutation can be rendered practically perfect under any condition of service. On account of the cost of adding the poles and the decrease in ventilation caused by their presence, it is claimed by some designers that the commutating pole construction is in general disadvantageous, because cheaper and more efficient machines can be obtained by omitting the poles and depending solely upon the careful arrangement of the armature coils, the selection of the proper number of commutator segments, and the correct proportion of the normal pole faces. It is claimed by such designers that the maximum speed of a given motor when properly proportioned is limited by mechanical considerations and not by sparking, so that the addition of commutation poles to prevent sparking is unnecessary. Lower speed can easily be obtained without sparking by strengthening the field, but only at the sacrifice of output, and the output cannot be increased by adding commutating poles.

The advocates of the commutating pole construction claim that by the use of interpoles the whole machine can be so redesigned that considerable saving can be effected in material, the efficiency can be increased, and the performance greatly improved. As has been aptly stated by one designer, "The commutating pole machine is a copper machine and not an iron machine." That is to say, the best design for commutating pole machines requires an increase in the proportion of copper to iron, as compared to the proportion in machines without commutating poles. On account of the fact that such a machine allows all of the active material to be fully utilized it will weigh less than a machine of the more usual design; it may not, however, cost less, because copper is more expensive than iron.

As to the excellent operating characteristics of commutating pole machines, no one who has witnessed their performance under adverse conditions can have any doubt whatsoever. It would probably be impossible to construct a commercial 5-hp motor without commutating poles which could be suddenly reversed under full load without producing any sign of sparking; yet when commutating pole motors are subjected to such treatment the resultant sparking is not noticeable. These facts were discussed at length on page 538 of our issue of March 18, 1905, in an article which treated of the commutating pole construction as applied to variable-speed shunt-wound motors.

A feature which cannot be ignored in the design of commutating-pole machinery is found in the fact that when the main field is allowed to be magnetically weak in comparison with the armature, and the armature m. m. f. is not counterbalanced over the whole polar surfaces, the resultant field in the air-gap may become much distorted, thereby causing an enormous increase in the voltage between certain adjacent segments on the commutator. This fact was discussed fully in an article abstracted on page 644 of our issue for March 30, 1907. Fig. 1, which has been reproduced from the article just referred to,

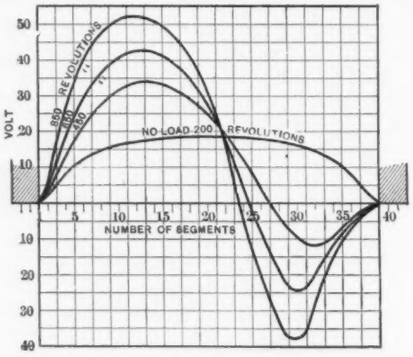


FIG. 1.—VOLTAGE BETWEEN ADJACENT SEGMENTS.

shows the relative increase in the voltage between segments as the field of a shunt-wound motor operated at full load is weakened to increase the armature speed. Even when the field is so distorted that it is actually reversed at certain positions, the commutating poles are able absolutely to prevent sparking at the brushes.

One of the earliest forms of auxiliary-field machines was the Thompson-Ryan generator as built by the Ridgeway Dynamo & Engine Company. As is well known, in addition to the usual shunt field winding arranged on projecting poles, this generator is provided with a series-connected winding completely surrounding the armature and interlaced in a symmetrical magnetic ring between the projecting poles and the armature surface. See Figs. 2 and 3. The series winding is designed not only to

FIG. 2.—POLE-RING COMPLETE WITH BALANCING COILS.

furnish a commutating field locally for the coil under the brush, but to counterbalance the magnetomotive force of the armature current and thus to prevent the distortion of the main field Due to the use of these so-called "balancing coils" the manufacturers are enabled to build the generator with a very small air-gap, a very weak main field and a correspondingly reduced loss of power in the shunt field coils. The armature is designed so as to be magnetically very strong; that is, with an extra great depth of copper, while the temperature rise is properly

limited by providing many ventilating ducts throughout the armature structure and the "balancing coil" ring. This company applies the Ryan balancing coils to its line of shunt-wound motors and thereby obtains a speed variation of 4 to 1 without sparking.

Our readers are familiar with the so-called "interpole" motors built by the Electro-Dynamic Company. In these motors no attempt is made to compensate for the armature reaction, but the "interpoles" supply a commutating field over the brush area. Midway between the main field poles are placed the extra poles provided with coils connected in series with the armature. See Fig. 4. The magnetomotive force of the current around the interpoles is greater than that of the armature locally at the brush area, so that not only is the field distortion overcome at this point, but an extra flux is provided for producing an e. m. f. in the coil under the brush in order to force the current in the coil to reverse completely before the commutator segment leaves the brush. Even at full load and extreme high speed, the interpoles are effective in furnishing a commutating flux, although the field may be enormously distorted and actually reversed at certain positions by the armature m. m. f.

FIG. 3.—POLE-RING IN PLACE IN FIELD FRAME.

In its standard line of variable-speed shunt-wound motors, the General Electric Company takes full advantage of the commutating pole construction, and by providing extra ventilation has rendered sparking and not heating the limiting feature in the design, the sparking being then eliminated by extremely thin auxiliary poles placed over the commutating space on the armature. The relative proportions of the main and commutating poles are clearly indicated in Fig. 5.

The Westinghouse Electric & Manufacturing Company has made special efforts to place the magnetizing windings on the auxiliary poles of its variable-speed motors as close as possible to the desired point of application of the m. m. f., and has aimed to provide the maximum of ventilation to the field coils. These facts are indicated in Fig. 6, which shows the arrangement of poles and field windings of a Westinghouse auxiliary pole motor.

The last two years have witnessed a most remarkable general application of commutating poles to practically every familiar type of direct-current machine. In high-speed turbo-generators the commutating pole construction is almost universally employed. In this case the problem is quite similar to that found with variable-speed motors; it is necessary to provide a field in the interpolar space of such value that the armature coil under the brush by its motion therethrough has generated in it an e. m. f. sufficient in value and proper in direction to cause the armature current to be completely reversed before the coil passes from under the brush. The auxiliary pole arrangement is so very effective that even at the highest possible speed, and with a minimum number of commutator bars, sparking under normal operation may be entirely eliminated. A point which should not be overlooked in the design of turbo-generators, but

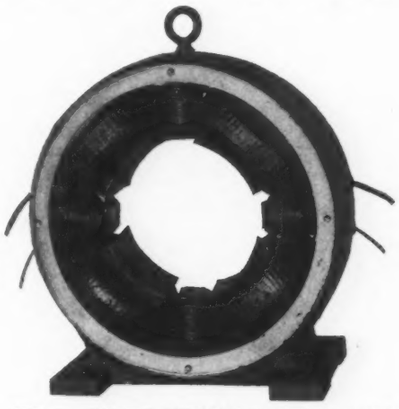


FIG. 4.—ELECTRO DYNAMIC INTERPOLE MOTOR.

which, perhaps, has not always received the serious consideration which it merits, resides in the fact that, while the proper adjustment of the voltage between the commutator segments under the brushes may serve completely to suppress the sparking and thus to render the performance faultless under normal conditions, yet the excessive voltage that may be allowed between adjacent segments at other parts of the commutator may give rise to certain other commutator troubles under abnormal conditions. It would seem that the best effects with reference to the elimination of the tendency to "flashing over" are to be obtained only when the distortion of the main field flux by the armature m. m. f. is prevented by the use of compensating coils. Thus not only must the armature m. m. f. be neutralized and overpowered locally at the brushes, but it must be properly counterbalanced over the whole pole area.

Among the numerous special uses to which the commutating pole construction is now being put may be mentioned the variable-voltage generator for mine hoisting and similar work. The momentary excessive values of current which are at times demanded from the armature of such a generator render the

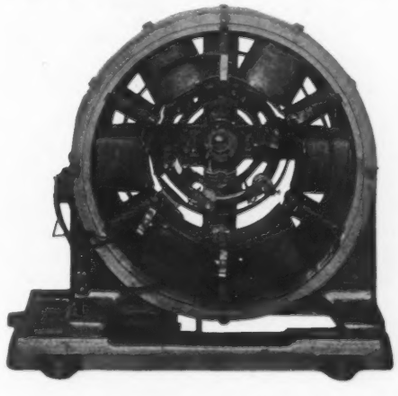


FIG. 5.—GENERAL ELECTRIC COMMUTATING-POLE MOTOR.

obtaining of sparkless operation extremely difficult with the ordinary design of direct-current generator unless an extra heavy machine is used. By the employment of commutating poles, however, the machine may be designed solely with reference to the allowable temperature rise, and hence the minimum amount of constructive material is needed.

A flywheel converter equipment the design of which along so-called standard lines would have been quite difficult, but which was rendered comparatively easy by the use of commutating poles on the generator, is illustrated in Fig. 7, which shows a

separately-excited variable-voltage generator directly driven by a shunt-wound specially-controlled direct-current motor. The heavy flywheel on the same shaft with the motor and the generator is used for energy storage purposes. When there is a demand on the generator the speed of the equipment decreases, and the flywheel gives up rotative energy, while it absorbs energy through the medium of the motor circuits when the generator is delivering no power, so that although the power demands on the generator fluctuate throughout a wide range the power taken by the motor is fairly constant. In order to allow the speed of the flywheel to decrease considerably without imposing too great a load upon the driving motor, resistance is inserted in the armature circuit of the motor according to the load on the equipment by means of the automatic rheostat shown in Fig. 7. For the purpose of eliminating all rheostatic losses in the circuits to the motors which receive power from the equipment, the generator is operated at a voltage variable by field control from zero to the full value, which fact accounts for the necessity for separately exciting the generator. The severe service demanded from the converter equipment, may be learned from Fig. 8, where the high peaks at the beginning of the cycles shows the current taken during the period of acceleration of the hoisting motors. It is about twice that taken during the constant-speed period and at constant voltage would represent about four times the practically constant power taken by the driving motor of the converter set. Even under these severe conditions satisfactory commutation can be obtained by the use of auxiliary field poles on the variable-voltage generator.

The conditions usually existing in constant-speed motor installations are such that the driving motor may be designed

FIG. 6.—WESTINGHOUSE AUXILIARY-POLE MOTOR.

with the temperature rise as the limiting factor rather than the commutation, so that the use of commutating poles would merely add to the expense without producing any adequate improvement in the operating characteristics. In constant-speed installations where the load is subject to rapid and violent fluctuations, or where an enormous overload must be carried for brief periods, the commutating-pole construction is particularly advantageous. By the use of such construction the main parts of the machine may be designed solely with reference to the mean heating effect and permissible temperature rise, while the commutation under momentary overloads of even several hundred per cent will be properly taken care of by the flux from the auxiliary poles. Thus, for intermittent constant-speed service a commutating pole motor will be less expensive than a motor of the more usual design.

A promising field for the use of commutating poles is to be found in high-voltage railway motors. In just so far as high-voltage motors are inclined to spark at the brushes there can be no doubt that the commutating poles will be of great assistance in improving the performance. It is not proper, however, to assume either that the sparking at the brushes with the more usual construction will be destructive, or that all of the commutator difficulties with high voltage are confined to the brush area. It must be remembered that in a series-wound railway motor when the armature current is large the field flux is likewise large and the conditions are relatively favorable to sparkless operation, while the heaviest currents are always taken when both the speed and the voltage at the commutator are low. When the machine is designed for increased voltage the difficulties that arise are not confined to the sparking at the brushes which may be attributed to the increase in value of the e. m. f. between the segments locally under the brush. The required in-

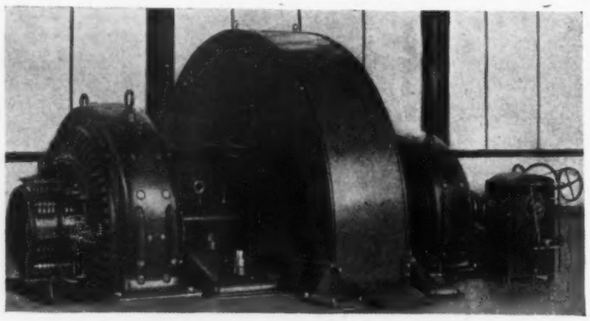


FIG. 7.—VARIABLE-VOLTAGE COMMUTATING POLE GENERATOR EQUIPMENT WITH LOAD REGULATOR FOR THE DRIVING MOTOR.

crease in the maximum e. m. f. between segments and the increase in the total number of segments to be used between neutral points, which necessitate either a higher peripheral speed, a fewer number of poles or smaller commutator segments, are factors which the auxiliary pole construction does not eliminate. The particular advantage of the auxiliary pole construction in direct-current railway motors resides in the ability of the machine to withstand enormous overloads for short periods, or to be continuously operated at excess power when artificial ventilation is used without encountering sparking as a limiting factor. An additional advantage is found in the fact that a motor thus constructed may be arranged for a considerable number of efficient normal speeds, by simply placing a variable resistance in parallel with the main field coils. The advantages in respect to the characteristics just noted are not limited to high-voltage motors; in fact, they can most readily be obtained when the normal e. m. f. is low. On account of the extra capacity which may be obtained from any completed motor structure when forced ventilation is employed with the auxiliary-pole construction for removing the sparking limit, it does not seem improbable that artificially-

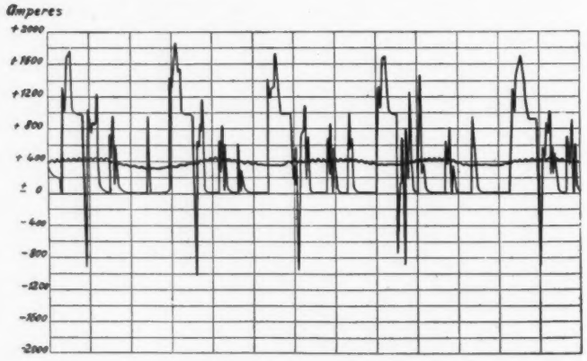


FIG. 8.—LOAD DIAGRAM TAKEN FROM A SIEMENS-ILGNER WINDING MACHINE.

cooled equipments may be introduced where the space for the motor is limited. The employment of high-voltage directly upon a single commutator renders desirable the application of some means for limiting the tendency to flashing at the commutator. Since such tendency is augmented by any abnormal field distortion, the preventive means may take the form of compensating coils for neutralizing the m. m. f. of the armature current.

Thus the construction that is now used for minimizing the inductive reactance of the armature circuit and thereby improving the power-factor and the torque-speed characteristics of the single-phase railway motor may find application in direct-current railway motors for another and entirely different purpose.

Test of a Producer Gas Engine.

Prof. G. W. Bissell of Iowa State College, Ames, Ia., presented a paper before the Iowa Electrical Association at Clinton, Ia., April 19, 1907, on "Producer Gas Engines." Much of the paper was taken up with a review of certain tests made by the United States Geological Survey during the Louisiana Purchase Exposition at the government testing plant there. The tests which might be of interest to Iowa central-station men were summarized, coals being selected which were similar to Iowa coals in their composition. These tests can be studied in detail by referring to Bulletin No. 261 of the U. S. Geological Survey, obtainable by application to the Survey at Washington. The latter part of the paper is devoted to a test on a hard coal producer gas engine at Algona, Ia., in the spring of 1906. The results are shown in Table I. The engine was a three-cylinder, vertical, Fairbanks-Morse engine, using gas generated from anthracite pea coal in a suction gas producer, also manufactured by the Fairbanks-Morse Company. The unit is rated at 150 brake hp at 250 revolutions per minute, and was guaranteed to give one brake hp-hour for not to exceed 1½ lbs. of anthracite pea coal for all loads above 75 brake hp.

TABLE I.

Revs. per min.	Brake load hp.	Lbs. Coal (as fired) per brake hp-hour.	Cost per brake hp-hour at $6.00 per ton.
250	40.1	1.511	$0.00453
250	82.7	1.157	.00347
250	156.9	0.999	.00299

Two tests were also made on this engine under service conditions, viz., belted to a 75-hp alternating-current generator. In addition to the lighting load, electrically-driven pumping machinery can be operated from this generator. Fig. 1 shows

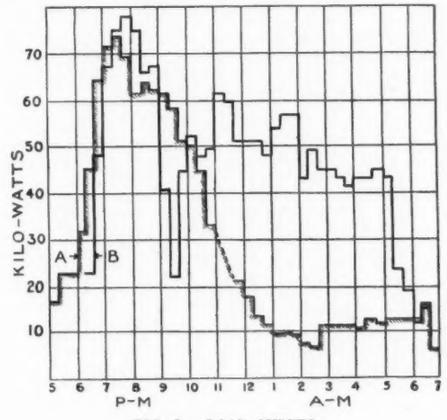


FIG. 1.—LOAD CURVES.

the load curve (A) during a service run with lighting load only and the load curve (B) for the combined load, the usual operating conditions, stand-by losses included.

At $6.00 per ton the cost of fuel per kw-hour at the switchboard for the load A was 1.207 cents including fuel for banking and starting, and for the load B was .639 cent, including also the stand-by losses. Soft coal from Illinois which was used for a Corliss engine unit in the same plant cost $3.40 per ton.

The following data apply to the curves A and B, Fig. 1:

A.—LOAD CURVE OF ALGONA PRODUCER GAS ENGINE, MARCH 15-16, 1906.
14 hour test. Output 409 kw-hours.
Anthracite Pea Coal per kw-hour = 4.10 lbs.
Fuel cost per kw-hour = $0.0123.
Load factor 18 per cent.

B.—LOAD CURVE OF ALGONA PRODUCER GAS ENGINE, MARCH 16-17, 1906.
12 hour test. Output 589 kw-hours.
Anthracite Pea Coal per kw-hour = 2.23.
Fuel cost per kw-hour = $0.00699.
Load factor 27 per cent.

For the purpose of comparison with this test, we may consider the case of a simple Corliss engine similar to that used in the government tests at St. Louis. The average coal consumption of that engine was 5.71 pounds per kw-hour. If this coal cost $3.00 per ton the cost of the coal per kw-hour would be $0.008565, which can be compared directly with the values given in connection with the Algona test.

It is difficult at this time to predict the immediate future of the producer gas engine, but the writer stated that this type of prime mover is destined to be a formidable rival of the steam engine, and as the price of fuel increases the field for the producer gas engine will enlarge. At present there is a question whether it will pay to install a producer gas engine where coal is cheap. The only advantage would be the compliance with the smoke regulation, but as a financial proposition it may be stated that owing to the fact that a producer gas engine installation costs probably from 50 per cent to 60 per cent more than a steam engine plant which would be its alternate, it will not pay to consider the installation of the gas producer plant with coal costing $1.50 or less per ton.

The question of the mechanical and operative advantages and disadvantages of the gas engine will not be discussed here except to say that there is no reason why the gas engine cannot be used satisfactorily for the generation of electrical energy for lamps and motors.

At the close of the paper Prof. Bissell asked as to the difficulties of oiling gas engine. He replied that the vertical cylinder type was said to be hard to oil and for that reason many thought the horizontal engine better. With horizontal engines there seemed to be little trouble. Being asked as to the steadiness of speed, he said that a multiple cylinder engine with a heavy fly wheel was sufficiently steady. Single-cylinder engines were likely to be unsteady unless equipped with very heavy fly wheels. He thought it rather important in operating gas engines that they be placed in the hands of men who are in sympathy with the gas engine idea. They are entirely different from a steam engine, and if the engineer does not like them they are not likely to get the right kind of attention. Mr. Austin Burt said the same thing was true in connection with introducing steam turbines.

Pithy Paragraphs on Central-Station Economy.

The following are some pointed paragraphs extracted from the paper read by Mr. Gus Lundgren, of Cherokee, Ia., before the Iowa Electrical Association at Clinton, April 18:

"If you but knew it, you cannot afford to operate one week without the scale for your fuel, the meter to measure the water you evaporate and the meter to show the amount of energy you have put over the switchboard into your lines. If you think that you do not need these scales and meters, then please go to the merchant and ask him how he knows what to charge for a pound of sugar. If he turned at you and asked you the same question about your energy, you would, if you told him the truth, have to say that you did not know.

"This may seem to be putting it strongly, but it is a fact that there are many electric stations in which there are many thousands of dollars invested that have no means of knowing the cost of energy. How can this be a safe investment? With no protection to the stockholders or to the customers, is it a wonder that failures in the electric central-station business are reported?

"But that is not the only advantage of the scales and meters. When everything is in good running order we find that it takes a certain amount of fuel to evaporate a certain amount of water and a certain amount of fuel to produce a certain number of kw-hours. If the meter on the boiler feed says that more water than usual has gone through it, it may be that this water

has not been evaporated, but instead has found another place to go; consequently, a leak is found. Then again, if the coal and water correspond, all right; but if it is found that more coal than water has been used per kw-hour, it is time to put the indicator on the engine to ascertain the condition of the engine valves or a leak may be found in the steam pipes.

"The writer was at one time working in a station where the use of the engine indicator aided in finding the trouble with the engine. We found a very badly set valve and after this had been corrected it resulted in a saving of $1.30 worth of coal from midnight until morning. This I consider a good saving for an engine of 75 hp.

"In testing coal before closing a contract, the scales and meters may be used for finding the evaporating power of the fuel. The question is how many kw-hours can be made per dollar's worth of coal. We do not care what kind of coal is being used, for a good talk from an agent will convert water into steam."

New Telephone Patents.

PORTABLE TELEPHONE DEVICE.

In practical telephone working there arises from time to time a demand for a portable telephone which may be attached to the line wire at will at any one of several points in different locations throughout the premises. As an example, take the case where a telephone is desired in the living room in the day and in the bedroom at night. Such arrangements usually require a desk telephone set connected to a plug with jacks mounted at each place of connection.

With a view toward improving the apparatus, S. C. Houghton, of Rome, N. Y., has invented a combined jack and switch box. The telephone set contemplated is of the hand microphone type, and from the top of the face of the box the hook switch projects. This switch is wired to the line on the one side and to the jack set in the bottom of the box on the other. The result is a neat, compact apparatus.

REPEATER CIRCUITS.

A short time since we noted at some length a patent to N. G. Warth, of Columbus, Ohio, for a telephone repeater arrangement.

In the figure is shown the conventional circuit of a later arrangement patented by this same inventor. In this device the novelty lies in the association in the line of two repeaters, each designed for transmission in one direction only. The

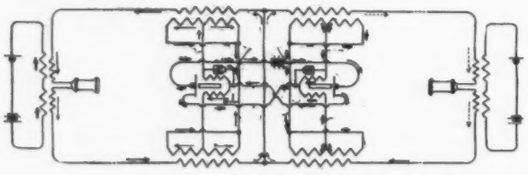


FIG. 1.—WARTH REPEATER.

line is short-circuited between the two, and thus there can be no backward direct action from one section to the other. As with the earlier arrangement, the success of the apparatus seems to depend upon the condenser shunted about one winding of the receiver differentiating between pulsating primary currents and alternating currents, although in this instance it is difficult to predict just what effect any failure of the receiver would have. The arrows indicate the course of the received, reinforcing currents and outgoing currents.

NEW MAGNETIC SIGNAL SYSTEM.

The magnetic signal which preceded the incandescent lamp for common-battery working always sufficed well as a line signal, but for supervisory purposes it has usually had a fundamental defect. The signal is usually connected directly in the line circuit, serving the entire purpose of supervisory signal. When current flows—the condition of use—the signal is energized and its target shows. The stoppage of current, either by the ceasing of a conversation or the return of the plugs to their seats, causes the target to be withdrawn. Herein lies the disadvantage, as the withdrawal of the signal has two opposite significations—one that the cord pair has not been in use, and the second that it should be disconnected. A differentially-wound signal or the introduction of a relay will suffice to invert the signal and make its indication positive. Both methods have been used.

Another scheme for doing this, invented by F. R. McBerty, of Evanston, Ill., is of a purely mechanical nature. The signal has two armatures, the coincident action of which withdraws the target, while the energization of one displays the target. In the cut is shown the circuit wherein this signal is used, which

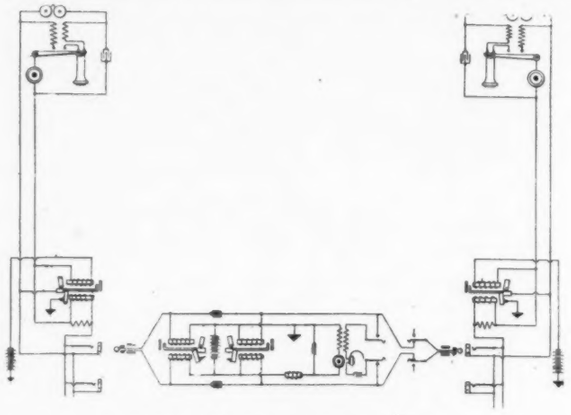


FIG. 2.—M'BERTY SIGNALING SYSTEM.

circuit has recently been patented by Mr. McBerty. The top armature, fallen back, overweighs the signal target. When this armature draws up, the target falls until raised by the energization of the lower magnet and the response of its armature. It will be seen that this lower magnet is in series with the subscriber's hook switch. Mr. McBerty has assigned his patent to the Western Electric Company.

NEW TRUNK CIRCUITS.

J. B. Kelley and E. B. Heaford are jointly the inventors of a local-toll trunk circuit providing the usual signals. A high retardation relay bridged across the trunk responds to the local cord battery to illuminate the calling signal. A retardation across the trunk cord forms an auxiliary path for the current, in which path is interposed two relays. One of these cuts off the signal lamps and locks itself through an auxiliary coil. The other puts a third shunt across the line of low enough resistance to permit the operation of the local cord supervisory. It seems probable that this circuit would have a serious effect upon transmission.

W. W. Dean has patented and assigned to the Kellogg Company a special trunk circuit for use between the two-wire system of that company and one of the older type switchboards. This provides the usual test and signals for such systems.

AUTOMATIC EXCHANGE APPARATUS.

Rather a novelty in automatic exchange selectors is that suggested and patented by J. G. Roberts, of Chicago, for he has done away with any translation of his switch shaft. The line contacts are arranged in the usual bank on the inside of a curved surface, ten high and ten wide, in the usual manner. A swinging arm carries the switch fingers across the face of these. There are, however, ten of these latter arranged on a rotating shaft carried at the end of the arm, and these are spaced vertically the same as the multiple spacing. They are again angularly spaced about the shaft so that the angular displacement of the shaft determines which of the ten fingers is in position to engage a horizontal row of multiples. The act of selecting then includes, first, the rotation of the shaft to bring into operative relation the desired horizontal row; and second, a swing of the arm to sweep the contact to the de-

sired vertical row. The Western Electric Company has been assigned this patent.

LETTER TO THE EDITORS.

Central Station Fixed Charges and Rates.

To the Editors of the Electrical World:

SIRS.—It has been pointed out many times how important a proportion fixed charges are of the total cost of serving an ordinary electric light consumer and how much difference it makes whether the consumer uses current one hour a day or twenty-four. Nevertheless, the general public fails to understand this and there are plenty of central station companies which do not take it into account in their rate schedules, however much they may bemoan the fact to themselves. The sooner this matter is thoroughly understood the better it is for everyone concerned. It is important that the public understand it in order that the reasons for high charges on electric lighting business which is on only during the peak can be understood. On the other hand, it is important to the central station man, who is trying to improve his load factor and increase his output without a proportionate increase in his peak load and generating capacity, to understand fully where he stands. Assuming as an average condition that a small or moderate-sized central station has an investment of $250 per kilowatt of maximum station capacity, and that the very conservative figure of 12 per cent for interest and depreciation should be allowed, it would have $30 per year fixed charges against every kilowatt of maximum station capacity. Now, if a lighting customer uses current only about one hour per working day on an average, or say 300 hours per year on the peak of the load, the fixed charges which should justly be paid by that customer would amount to 10 cents per kw-hour. To this must be added the operating costs necessary to supply him, which costs would, of course, be considerably less than the fixed charges. If the customer's load continues eight hours per day for 300 days per year, his fixed charges per kw-hour come down to 1.2 cents, while for 24 hours they are only .4 cent per kw-hour. In other words, with short-hour business fixed charges are by far the heaviest item, while on the very long-hour business the fixed charges become insignificant. It goes without saying that considerable purely peak load business is carried by every central station company at a loss. If the company's operations show a profit, it is at the expense of the consumers who use current a number of hours per day. This is undoubtedly true even in the case of central station companies which make an attempt to charge each class of consumer what his service is worth, and to favor the long-hour consumer. What takes place in the majority of companies where the long-hour consumer is favored very little by the rate schedules in vogue can be surmised.

To the man operating a central station the two points of practical importance in the foregoing discussion are, first, the necessity of educating the public and consumers generally to the relation of fixed charges to rates; and second, the importance of recognizing that the fixed charges on non-peak business are considerably lower than on peak business and that he can afford to make rates correspondingly lower on long-hour and non-peak business. There is usually a lot of non-peak business which can be secured if rates are made low enough, but which can never be obtained at the rates charged for peak load business. This includes power for operating manufacturing establishments, heating, cooking and the like. Of all the central station companies which have been notably successful, I know of none which has not recognized the value of the long-hour and non-peak business and has made low rates to capture it. It takes a lot of business which is on only a few hours per year at peak rates to equal either in gross or net revenue a small, steady, non-peak load. A great many managers take the narrow view that the making of low non-peak rates will make trouble with the peak customers. There should be no trouble when the matter is properly explained to customers except with the few who are chronic fault-finders, and from whom criticism must be expected whatever policy is adopted. The question of proper rates for non-peak business is of vital importance to the future of any central station company because upon its policy in this respect will be determined whether the company is to continue losing money on an output which is delivered almost entirely during peak load hours, or whether it is to have a good all-day load with a fair margin of profit.

CHICAGO, ILL. JAMES R. THORNTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Turbo-Alternator.—A. HEYLAND.—An illustrated article on a two-pole turbo-alternator with stationary field and magnetically shunted exciter. The author draws attention to the large amount of active material which must be expended in the usual type of turbo-alternator in order to keep the voltage drop within reasonable limits, and discusses means of reducing the capital cost of such machines, with special reference to two-pole machines. He proposes to solve this problem by designing such machines with a rotating armature and stationary field, and by applying at the same time his method of automatic voltage compensation recently described in ELECTRICAL WORLD. In the proposed design the alternator and exciter have a common field system. The flux through the exciter is a stray flux from the main field, and it increases and decreases with the armature reaction of the alternator, so that an instantaneous and complete voltage compensation is obtained at all loads. The advantages of the new design are illustrated by a numerical comparison between a 500-kw alternator of usual design and a similar machine in accordance with the author's proposals.—Lond. *Elec.*, April 12; *Elek. Zeit.*, April 11.

Alternating-Current Series-Shunt Motor.—M. OSNOS.—An illustrated description of a series-shunt motor of the Felten & Guilleaume-Lahmeyer Co. It is stated to be specially suitable for traction purposes, but in the present article only its use as an elevator motor is discussed. The author first reviews the properties of the compensated-shunt motor, the Atkinson repulsion motor and the compensated-series motor and concludes that the compensated-series motor has the right properties for starting and the compensated-shunt motor the right properties for running at normal speed. He, therefore, combines both motors

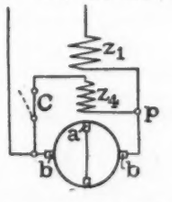


FIG. 1.—ALTERNATING-CURRENT MOTOR.

in one machine as shown in Fig. 1. If the winding z was absent, the motor would be a compensated-series motor. For starting, therefore, the switch C is open. When the motor has run up to a certain speed the switch C is closed and the motor behaves like a shunt-motor with constant speed. The author gives the general laws of the maximum torque and the minimum consumption of volt-amperes per meter-kilogram for single-phase commutator motors and describes various arrangements

of his motor, with series transformers and auxiliary windings on the stator. He also gives results of tests of various motors of this type.—*Elek. Zeit.*, April 11, 18.

Direct-Current Windings.—N. Gennimatas.—A mathematical article on the direct determination of the number of elementary groups between two adjoining commutator segments of a direct-current winding closed on itself.—*Elek. und Masch.*, March 24.

Commutating Motors.—F. Pelikan.—An article giving formulas for finding the proper dimensions of commutating pole width, tooth pitch and brush width.—*Elek. und Masch.*, March 31.

Lamps and Lighting.

Temperature and Light Emission of Carbon, Osmium and Tungsten Lamps.—A. Grau.—For the carbon-filament lamp operated at three watts per hefner candle-power, the following values have been found for the temperature of the filament: Lummer and Pringsheim by means of bolometric methods found that the temperature must be between 1602 and 1827° C. H. F. Weber concluded from his radiation formula that the temperature is between 1565 and 1580 degrees. C. W. Waidner and G. M. Burgess found the temperature to be 1860 degrees. The present author concludes that the two last-named determinations cannot be correct since they ought to fall within the limits of Lummer and Pringsheim's determinations and from his own measurements with a Wanner pyrometer. He found the black-body temperature of the carbon filament at three watts per hefner candle-power to be 1660 degrees C. He also made measurements with osmium and tungsten lamps, and gives in curves the relation between the amperes passing through the lamps and the temperature of the filament for the different types of lamps. Among further results obtained by the author the most interesting appears to be that given in Fig. 2, in which the

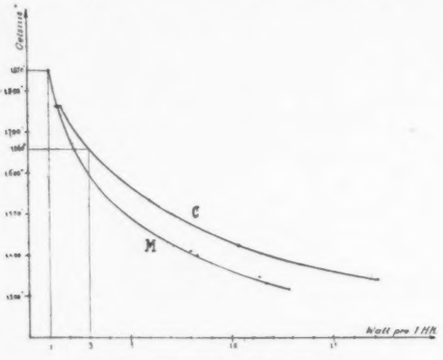


FIG. 2.—TEMPERATURE CURVES.

temperature of the filament in degrees C. is given as function of the number of watts per hefner candle-power. The curve *C* refers to the carbon filament, while for the three metallic filament lamps (two tungsten and one osmium) the same curve was found which is indicated by *M*. The curve *C* is higher than the curve *M;* that means that for the same temperature of the filament the economy of the metallic-filament lamp is higher than that of the carbon-filament lamp. With respect to economy, tungsten and osmium lamps should be equivalent, but osmium cannot be maintained continually at the same high temperature as tungsten, because osmium begins to disintegrate earlier than tungsten. With increasing temperature the curve *C* gets near the curve *M* and probably the two curves will intersect between 1800 and 1850 degrees C. The economy of the carbon-filament lamp would then be even higher than that of the tungsten lamp, but it cannot withstand such a temperature for any length of time. The temperature of the normal carbon-filament consuming three watts per hefner candle-power is 1660 degrees C. The temperature of the tungsten-filament consuming one watt per hefner candle-power is 1850 degrees C.—*Elek. und Masch.*, April 14.

Moore Vacuum Tube.—C. J. Thatcher.—An article on the Moore vacuum tube lamp and the luminosity of gases. After a description of the Moore tube and a brief discussion of the theories of gaseous luminosity, the author emphasizes that with the Moore tube it has been found necessary to feed very small portions of air or other gas every minute or so during use of the tube. The author says this indicates that the lighting of the Moore tube is necessarily accompanied by a chemical reaction and this chemical reaction is most probably the formation of certain nitrogen oxides.—*Electrochem. and Met. Ind.*, May.

Ballast Resistances for Voltage Compensation.—P. Lauriol.—For the lighting of the crematory of the Pere-Lachaise cemetery direct current of greatly fluctuating voltage (between 400 and 500 volts) was available. To get a more uniform voltage for the incandescent lamps they are used in connection with the well-known ballast resistances of the Nernst lamps in the way repeatedly described in the Digest.—*L'Eclairage Elec.*, April 20.

Power.

Power Plant in Tyrol.—A long illustrated description of the Sill hydro-electric power plant near Innsbruck. It is the largest hydro-electric plant of Tyrol. There will be six machine sets, of which only two have so far been installed. They have an efficiency of 80 per cent and run at 350 r. p. m. and produce each 2500 horse-power. The energy is used in three different districts. The first is the city of Innsbruck, the capital of Tyrol; the second comprises the most important towns in the upper Stubai Valley, and the third is the Stubai Valley Railway. Since there was in use a two-phase 42-period net-work in Innsbruck, the Sill works were also equipped for the two-phase system with a frequency of 42. The transmission voltage from the plant to Innsbruck is 2000. The hydraulic, as well as the electric equipment, are described in detail and illustrated.—*Elek. und Masch.*, March 24 and 31.

Italian Power Plant.—A note on the Brusio power station which supplies electric energy to the Poschiavino Valley and to the electrically operated Bernina Railroad. The Societa Lombarda in Milan has rented 16,000 kilowatts to supply the industrial districts in the south of the Como and Langen Lakes. The generating plant contains at present six 3000-hp machine sets. In the course of this year four other sets will be erected and in 1908 the last two sets of the same size, so that, when completed, the station will have a capacity of 36,000 horse-power, and will be the largest power plant of Continental Europe. Three-phase currents are generated, and the transmission voltage is 47,000. The total length of transmission is about 100 miles. The plant was opened during March of this year.—*Elek. Zeit.*, April 11.

Norwegian Power Plant.—The Schuckert Company has recently enlarged its plant in Kykkelsrud, in Norway, by two 3750-hp dynamos, and three other sets each of 8000 horse-power are soon to be erected. Three-phase currents are transmitted at 50,000 volts to a chemical factory at a distance of 25 miles.—*Elek. Zeit.*, April 11.

Traction.

Multiple-Unit System.—An illustrated description of a new method of multiple-unit train control, in use on the Lancashire & Yorkshire Railway's Liverpool-Southport electric line. It is the development of a principle introduced by T. von Zweigbergk, of Dick, Kerr & Co. The main feature is the use of solenoid contactors with series, as distinct from shunt, magnets. These magnets are energized by the return current from the train motors, which is either passed through all the control magnets on the train to earth at the rear of the train or diverted to earth at the front of the train. No current is broken in the controller; only the contactors, with metallic shield blow-outs, interrupt the motor circuits. The control wires are at earth voltage at all times. The description includes an account of the principle adopted, with simple diagrams and details of the parts employed to make up the control of a train. The application of the system to a four-motor coach is also described.—Lond. *Elec.*, April 19.

Electric Traction on Railroads.—P. Dawson.—The first part of a serial dealing with some general considerations. The author first considers the various causes which have led to the electri-

fication of railways, and classifies them accordingly. These causes vary in different countries, and thus the conditions which have led to electrification elsewhere do not necessarily apply in England. Financial considerations are the governing factor. High acceleration is one of the most important advantages of electric traction, and another is the greatly increased terminal facilities.—Lond. *Elec.*, April 19.

Three-Speed Polyphase Locomotives.—B. VALATIN.—In order to get three different speeds with the Granz three-phase system on the Italian state railways, the locomotives are provided with two motors, the one having 8 poles and the other 12, being wound for 3000 volts at a frequency of 15. By using each of these motors alone the two highest speeds are obtained, and by coupling them on the cascade system a third lower speed is obtained. The stator of the 12-pole winding has three windings for each phase. If the stator is connected to 3000 volts, the three windings in each phase are connected in series and the three phases are connected in star fashion. In the cascade system the three windings are in parallel and the three phases in delta. The three speeds are 64, 42 and 25.5 km per hour when the number of poles are 8, 12 and 20 respectively. At the higher speeds the tractive effort is 3500 kg, and at the lower speed 6000 kg.—Lond. *Elec.*, April 19.

Johannesburg.—An illustrated description of the tramway system of Johannesburg. These tramways have been transformed from horse haulage to electric traction during the last two years, and their length has been extended from 12 miles to 30 miles.—Lond. *Elec.*, April 12.

Installations, Systems and Appliances.

Voltage Rise in Direct-Current Networks.—R. HIECKE.—An article referring to a recent investigation of Feldman and Herzog, who had found that oscillations with a high voltage and frequency may occur in direct-current networks. The present author does not agree with the argument and shows that oscillations which were accompanied by dangerous rise of voltage can occur in armored single cables, such as used in direct-current networks, only in very exceptional cases which are hardly ever found in practice.—*Elek. Zeit.*, April 11.

Wires, Wiring and Conduits.

Insulation.—O. J. WILLIAMS.—A paper read before the New Castle section of the (British) Institution of Electrical Engineers on the insulation of electrical appliances. The author points out the theoretical necessity and the practical difficulties of grading the dielectric. He formulates some insulation rules as follows: "When the layers may not be closely compacted together for fear of losing flexibility, as in paper cables, or when the layers, as in rubber cables, have to be composed of dissimilar compounds, to economize the expensive insulators or to separate the copper from sulphur (1) avoid crumpling the paper; (2) see that the insulating oil in which the paper is soaked is of about

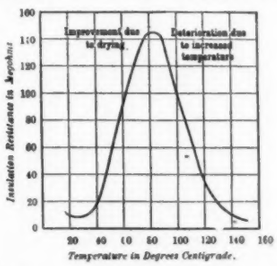

Improvement due to drying.
Deterioration due to increased temperature
Insulation Resistance in Megohms
Temperature in Degrees Centigrade.

FIG. 3.—INSULATION CURVE.

the same specific inductive capacity as the paper; (3) for rubber cables see that there is not too great a difference between the composition of the coats; (4) avoid air bubbles." The troubles due to a single bubble was pointed out. If there are minute drops of conducting liquid in a porous insulator they tend to collect together into bigger drops (like water drops in a thunderstorm) and to short-circuit the insulation. The shape of the electrodes is of great influence on the breakdown strength. The plate and pole test is of no use since there is nothing like it in practice. The needle-point test is uncertain owing to the varying condition of the points. The plate and plate tests are the best analogy to ordinary practice. The improvement obtained by drying and varnishing is discussed. Fig. 3 shows the influence of moisture and temperature on the insulation resistance of plain cotton duck. It shows the improvement in the insulation resistance due to drying of the fabric up to 80 degrees C. when it begins to burn. The curve is really the result of three phenomena: (1) the change of resistance due to temperature; (2) the change of resistance due to drying off the conducting liquid; (3) the change of resistance due to chemical change of

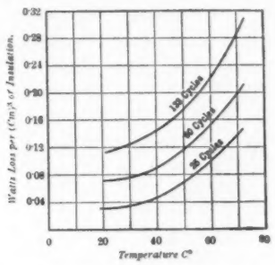


FIG. 4.—CURVE OF INSULATION LOSSES.

the nature of the fabric. This curve makes it quite clear that even if one does get the magnificent test insulation resistance of 140 megohms, there is not the least likelihood that under ordinary working conditions one will get anything like this. "The machines will sweat during the night, and what is your insulation resistance in the morning?" The deterioration of varnishes, etc., is largely due to mechanical vibration which powders them up, but the more flexible insulators deteriorate by charring. Fig. 4 gives the variation of the insulation losses with frequency and temperature. It shows that doubling the frequency does not double the loss, but that there is a gradually decreasing loss per cycle as the frequency goes up, owing to the time required for charging and discharging the dielectric. Still, the very fact of there being an increase of the loss at all due to frequency shows that energy is absorbed in taking the dielectric through its cycle of electrification, just as energy is absorbed in magnetic hysteresis in taking a piece of iron through a cycle of magnetization. The curves also show that the rate of increase of loss is greater at high than at low temperatures, and the desirability of keeping down the initial temperatures.—Lond. *Elec.*, April 12.

Method of Laying Cables.—A note on a new method of laying cables recently devised by J. S. Highfield. It is especially adapted for high-tension direct-current systems, and its object is to approach as nearly as possible the condition of overhead working with underground cables. The cables are drawn into iron pipes, and are supported therein on concentric insulators. A constant supply of dry air is forced into the system, and is allowed to escape through valves. As long as everything is in working order the leakage past these valves is constant, and the pressure, as indicated by gauges, is constant. If the pressure drops in any part of the line a fault may be suspected on that section. The advantages of using compressed air are that water can be kept out and the insulation is improved. Bare stranded conductors coated with an insulating skin are the best to use. The surface of the insulators is corrugated to reduce surface leakage, and at corners and bends the piping may be filled up with some hard material, such as asphalt. Boxes where the cables are anchored are laid at suitable intervals in the pipe line.—Lond. *Elec.*, April 19.

Electrophysics and Magnetism.

Pinch Phenomenon.—P. BARY.—An article on the phenomena observed in liquid conductors when a sufficiently strong current passes through them. A striction is observed, the cross-section of the conductor being diminished. If the current is strong enough the circuit may be broken. An interrupter based upon this phenomenon is described and also an application of the same phenomenon to the electric pulverization of metal. The author then deals with the movements produced in the liquid

conductor by the passage of a current, and with the e. m. f.'s generated in the conductor. He then deals with the effect of striction in gases and applies it to the theory of the singing arc and the speaking arc, and finally discusses the phenomenon in rarified gases. His conclusions are as follows: In solid conductors the electromagnetic striction effect cannot manifest itself on account of the great cohesion of the molecules on one hand, and the small coefficient of compressibility of metals on the other hand. Whatever may be the amount of the effect it acts so as to increase the apparent coefficient of self-induction. With liquid conductors there is always observed a tendency to break the circuit and sometimes the circuit is really interrupted. This tendency is accompanied by movements in the liquids and if the current is alternating or discontinuous the movements manifest themselves and produce waves on the surface of the liquid. In gases at normal pressure, where the mobility is even greater than in liquids, the striction effect manifests itself even with relatively small currents and the variations of the section of the conductor follow the variations of the current, even if very rapid, with great accuracy (speaking arc); under proper conditions of experiment a periodic interruption is obtained (singing arc). In rarified gases the effect seems to be even more pronounced so that the current passing through a vacuum tube even at constant direct potential is always discontinuous.—*L'Eclairage Electrique*, April 13.

Electric Conductivity of Alloys.—R. Schenck.—For alloys which are mixtures of their components the conductivity is an additive property. On the other hand, with alloys which are solid solutions a diminution of the conductivity is observed when adding the second metal. The decrease of thermal conductivity is relatively smaller than the decrease of electric conductivity. The author applies the kinetic theory of gases to a system consisting of electrons and molecules and arrives at the conclusion that the solution of one metal in another does not diminish the number of electrons and that the decrease of electric conductivity is essentially due to a change of friction resistance.— *Phys. Zeit.*, April 15.

Demonstration Apparatus.—C. Dieterici.—A description of a small electromagnetic rotation apparatus for demonstrating the magnetic fluxes which are produced by tube-formed conductors through which currents flow in longitudinal direction.—*Phys. Zeit.*, April 15.

Electron.—M. Wolfke.—A mathematical paper on the electron considered as a pressure center in the ether.—*L'Eclairage Elec.*, April 20.

Zeeman Phenomenon.—C. Runge.—A paper in which the author shows that the complicated resolutions of spectral lines heretofore observed in a magnetic field may be represented by a certain formula which gives the relation between the distances of the components from each other and the ratio of charge to mass of an electron.—*Phys. Zeit.*, April 15.

Electrochemistry and Batteries.

Electrometallurgy of Iron and Steel.—J. W. Richards.—A discussion of the various applications of the electric current in iron and steel metallurgy. The author first gives the thermochemical data for the problem of reduction of iron ore in the electric furnace and gives a full calculation of a run of the Heroult furnace at Sault Ste. Marie for the production of nickeliferous pig iron. The working thermal efficiency of this furnace is found to be 46 per cent. He then discusses the production of steel in the electric furnace. There are three methods of producing steel electrically which are practicable. First, the electric furnace may replace the crucible simply as a melting apparatus, in producing a cast steel from cemented bars. Second, the electric furnace may replace the crucible or open-hearth furnace as an apparatus in which to melt together wrought iron and pure cast iron, such as washed pig metal, although in this operation the electric furnace is more like the crucible method, in that there is not necessarily any oxidation of the metal or of its impurities in the operation. Third, the electric furnace may be used to melt or keep melted cast iron, while its impurities are oxidized out by additions of iron ore, in this operation resembling the Uchatius method of making crucible steel or the "pig" and "ore" process of making steel in the open-hearth furnace. The particular advantages possessed by the electric furnace processes are, compared with the crucible process, the larger quantities in which the steel can be made in one operation, the absence of carbon in the furnace lining, thus controlling better the carbon and silicon in the steel, and the higher temperature, enabling a more basic slag to be kept fluid and thus sulphur to be better eliminated. The advantages compared with the open-hearth furnace are the absence of gases of combustion in contact with the metal and the higher temperature available, which permits of very basic, refractory slags being made and kept thinly fluid, and thus gives better control of sulphur and phosphorus. In addition to these, in both cases, may be mentioned the commercial advantages, for the saving in crucibles alone makes the electric furnace superior in this respect to the crucible process, and the electric furnace can compete successfully as regards cost with the regenerative open-hearth furnace wherever water power costs less than $10.00 per hp-year and coal costs over $5.00 per ton. Various numerical examples are given on steel production in the electric furnace and finally the electrolytic refining of iron by the Burgess process is numerically discussed. The author finds that the total cost of refining is about $4.50 per ton of pure iron. With cheap, soft steel used as the raw material, there is a striking possibility of such a process being commercially practicable for furnishing one of the raw materials for producing the finest qualities of steel, the other raw material being washed pig metal of standard quality. This possibility is commended to the makers of fine steel.—*Electrochem. and Met. Ind.*, May.

Electric Steel Furnace.—A profusely illustrated description of a 736-kw, 24-ton induction furnace for steel manufacture which has recently been installed at the Roechling iron and steel works in Voelklingen, Germany. A list of induction furnaces now in industrial operation is given, among which is one in the United States and nine in Europe. One of the latter is a 150-ton mixer now in course of construction at Voelklingen which will be used as a reservoir to keep the hot molten metal which is tapped from the ordinary metallurgical furnaces and which is to be refined in the electric furnace in molten condition. Figures are given showing how the electrical energy required per unit of output has been decreased with increasing size of the furnaces constructed.—*Electrochem. and Met. Ind.*, May.

Berthelot.—C. A. Doremus.—An account of the life and work of the late P. E. M. Berthelot with portrait of Prof. and Madame Berthelot.—*Electrochem and Met. Ind.*, May.

Units, Measurements and Instruments.

Static Electrometer.—Th. Wulf.—A description of a new electrometer for static charges. He uses thin quartz threads

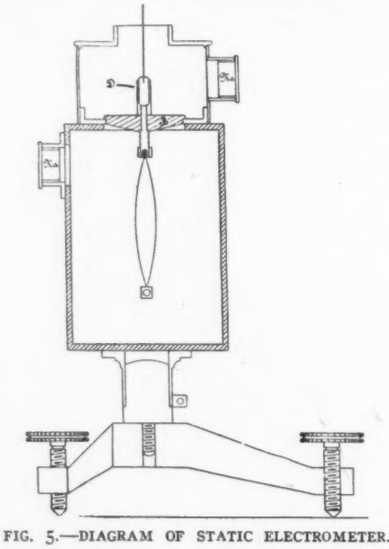


FIG. 5.—DIAGRAM OF STATIC ELECTROMETER.

which are made conductive by means of an adhering and very thin coating of platinum obtained by means of cathode disintegration. Two such quartz threads of about six cm length or less (according to the desired sensitiveness) are suspended side by side, and to their lower ends, which are connected together, is fastened a little piece of tinfoil. This system is insulated. When charged the threads repel each other. The distance between the two threads is a maximum at their center and at this point the distance is measured by means of a microscope and gives a measure for the potential. The instrument is shown in Fig. 5. The support *D* for the two threads passes through the amber plate *B*. At the places marked *Na* small pieces of sodium are placed when there is high humidity in the air. The instrument is totally enclosed in a brass frame with the exception of a window to let the light enter. The system of the threads is so light that the air resistance damps it almost completely so as to make the motion practically aperiodic; vibrations of the foundation are therefore not a disturbing factor in taking the readings.—*Phys. Zeit.*, April 15.

National Physical Laboratory.—An abstract of the report of the director of the (British) National Physical Laboratory for 1906. The researches of electrical interests are dealt with. This report has already been noticed in the Digest.—Lond. *Elec.*, April 12.

Telegraphy, Telephony and Signals.

Transmitter for Electromagnetic Waves.—J. SAHULKA.—An illustrated article on a transmitter which he has patented for producing undamped oscillation and which he believes to be suitable for wireless telephony, though he thinks it is inferior to the new Duddell-Poulsen transmitter.—*Elek. und Masch.*, April 7.

Miscellaneous.

Production and Price of Copper.—J. B. C. KERSHAW.—A statistical article on the production and price of copper for the period of 1889 to 1906. The chief features of the copper production in this period in the different leading countries are the enormous increase in the output of the United States mines during the last 18 years and the rise of Mexico from the position of very slight importance to the second place in the copper-producing countries. Figures are given on the price fluctuations and it is said that the present period of high values has been due to the enormous increase in the demand for copper during the past ten years, an increase which has been caused very largely by the consumption of the metal for electrical engineering purposes. The author thinks that it would be worth while for electrical engineers to try the use of substitutes for copper. —Lond. *Elec.*, April 19.

Soil Electrolysis.—H. BASSETT.—A paper read before the Society of Chemical Industry. Wandering earth currents, due to leaks from wires and earth returns on tramway systems, usually manifest themselves by causing the corrosion of metallic pipes, etc. In this case the pipe corroded acts as anode, the surrounding earth being the electrolyte. At the cathode alkaline deposits are formed. The author recites a case which occurred in Liverpool when there was a bad earth. A deposit of not less than two pounds had formed in this case which consisted chiefly of potassium and sodium hydroxides, with a certain amount of the free metals. Of course, the chemical reaction by which this was formed necessitated the evolution of a large amount of hydrogen. If this gas had been evolved in any position in which it could have accumulated and have gotten mixed with air, a violent explosion could quite easily have been caused, either by a flame being brought near or simply by a globule of the liquid sodium-potassium alloy coming in contact with water and causing a spark. The author thinks that many of the explosions in connection with electric lighting mains, usually attributed to the accumulation of coal gas, are very possibly in reality due to hydrogen formed by electrolysis.—Lond. *Elec.*, April 12.

Gavey.—An account of the proceedings at the complimentary dinner tendered to Mr. John Gavey on the occasion of his retirement from the position of engineer-in-chief of the British Post Office. There is also given a biographical sketch, with portrait, of his successor, Major W. A. J. O'Meara.—Lond. *Elec. Eng'ing*, April 18.

BOOK REVIEW.

TABLES FOR THE COMPUTATION OF ILLUMINATION. By Wm. E. King. Dorchester, Mass.: Published by the author. 54 pages. Price, $2.

These tables are intended for the use of the illuminating engineer in calculating the illumination falling on a horizontal surface at various distances from the source of light or, in other words, what is commonly known as the horizontal illumination. Its use will save considerable drudgery in connection with illumination calculations. Various short cuts have been suggested from time to time, but these tables seem to simplify matters more than anything heretofore brought out. What the author has done is to prepare from well-known formulas a table for each common height of lamps, one column of which table gives the angle from the perpendicular through the lamp; the next column the illumination received from a source of light equal to unity, and a third column the distance from the foot of the perpendicular at which the rays of light at the various degrees will be intercepted by the horizontal plane upon which the calculations are being made. All mention of units, such as candle-power and foot, have been left out of the tables, so that they can be used without confusion in countries where units other than foot and the candle-power are in use. The values in the tables apply, of course, to any system of units. For the sake of explanation, however, it is somewhat convenient to refer to candle-power and foot values, as they would be used in the United States. The tables cover heights of from 5 ft. to 30 ft. in 5-ft. steps, one page of the table being given to each step. To use the table in calculation, therefore, it is only necessary to turn to the page bearing the height at the top, find in the distance column the nearest distance from the foot of the perpendicular drawn through the lamp and read the illumination that would be obtained from a lamp of one candle-power in the adjoining column. This illumination has then only to be multiplied by the candle-power of the ray to get the illumination; or, if the worker prefers to get the illumination at various angles rather than a certain number of feet distant from the perpendicular, he can first locate the angle in the column of angles and find his unit illumination in the adjoining column. In the fourth column is given the candle-power of the source, which is necessary to give unit illumination at a given height and distance. The tables can, therefore, be worked either way —to obtain the value of the illumination under any plane surface or to determine the amount of light necessary to give any required illumination.

New Graphite Lubricant.

Mr. E. G. Acheson, the discoverer of the process for making artificial or manufactured graphite, as well as carborundum, has invented a process whereby graphite remains permanently and thoroughly suspended not only in oil, but also in water, in which forms it will take the place of oil as an agent for all classes of lubrication.

In 1901, Mr. Acheson had engaged in a series of experiments having as their object the production of crucibles from artificial graphite, which led him to study clays, and he found that a moderately plastic, weak clay, when treated with a dilute solution of gallotannic acid or extract of straw, was increased in plasticity. It was in the latter part of 1906 that Mr. Acheson realized that possibly tannin might have the same effect on graphite that it had on clay, and when he tried it the results were satisfactory. Among the experiments made with unctuous graphite of Mr. Acheson's manufacture, which might properly be termed disintegrated unctuous graphite, was the following:

To one sample of this graphite plain water was added, and after rubbing it in a mortar it was poured into a test tube.

To another sample of the graphite and water a little gallotannic acid was added, also a few drops of ammonia, this last, it being stated, as not absolutely necessary, but having been found to improve the result with some waters. This second mixture was rubbed in a mortar as in the first case, and then it was poured into a second test tube. Both tubes and their contents were thoroughly shaken, and simultaneously placed in a rack to settle. When about two minutes had elapsed after the shaking it was found that the graphite in the plain water had very completely separated from the water, not being miscible therewith, while the mixture of water, graphite, tannin and ammonia remained as black as when originally shaken up. The graphite was thoroughly suspended and showed no disposition to settle or separate.

Next from a bottle containing a quantity of graphite, water, tannin and ammonia, which had been mixed some weeks, a quantity was poured into a glass funnel containing one of the finest filter papers made in America. The deflocculated graphite ran through the fine filter paper and collected as black as ever in the tube below, apparently unchanged. Its passage through the paper was remarkably rapid, leaving no doubt that it was thoroughly mixed; and in order to demonstrate that the black liquid was a mixture of water and a solid body—graphite—a few drops of hydrochloric acid were introduced into the test tube containing the mixture. This was slightly warmed over a spirit flame, causing the suspended graphite to flocculate, so that when the liquid was again poured into a filter paper, the water ran through clear, the graphite remaining on the paper. A small quantity of this graphite was removed from the filter paper and rubbed on another paper, where it was dried. Then a brisk rubbing with the finger brought out the full lustre of the graphite. Mr. Acheson has obtained this "effect" with amorphous bodies generally, alumina, lamp black, clay, graphite and siloxicon, the only exception being magnesia, which needs further tests.

In its deflocculated condition, as produced by Mr. Acheson, graphite has a condition of fineness far beyond that attainable by mechanical means. In fact its condition resembles, if not wholly approaches, the molecular state. The "Acheson Effect" makes it possible not only to reduce graphite to practically the molecular state and to cause it to remain suspended in water for an indefinite period of time, but it has the further effect of preventing rust or corrosion while associated with water, thus deriving the advantage of the high specific heat and low viscosity of water and making of the new product a lubricant of the highest efficiency.

After he had succeeded in deflocculating graphite and causing it to remain suspended in water, Mr. Acheson turned his attention to solve the problem of replacing water as a conveyor of the deflocculated graphite with petroleum. He first directed his attention to diminishing the quantity of water by evaporation, leaving the graphite in a dry state, to be rubbed up later in oil. This method produced what at first seemed to be an ideal result, but it was discovered that in a comparatively short time the graphite had settled out of the oil, having lost its deflocculated condition and returned to its original condition. Consequently it was not in condition to remain suspended in oil or water, nor, very strangely, was it possible to suspend it again in water. In the face of this failure, however, the desired result was eventually accomplished, and with his disintegrated unctuous graphite, which is guaranteed to contain less than 1 per cent impurity, and can be mixed with oils, or grease as may be desired for all specific uses; with his deflocculated graphite in water for the lubrication of steam engine cylinders and other places and parts where the introduction of oil is objectionable; and with his deflocculated graphite in oil, the quantity carried by the oil being varied to suit requirements of the most difficult lubrication, Mr. Acheson feels assured he can meet any demand for a lubricant. It is claimed that the very lightest and thinnest of oils when used in conjunction with deflocculated graphite, can be used in the place of the heavy and expensive lubricating oils of the present day, and that the lasting qualities of these graphite lubricants will be greater by far than the oil lubricants which have been commonly employed heretofore.

Concrete Poles.

The substitution of concrete for wood for poles in transmission lines has been proposed from time to time, but apparently no general use has as yet been made of concrete poles. Added interest is given to the proposals at the present time on account of the fact that the Windsor, Essex & Lake Shore Road, of Windsor, Ont., Can., has ordered from the Concrete Pole Company, of St. Catharines, 100 concrete poles for use this coming season. It should be noted in this connection that about 15 miles of transmission lines have already been equipped with such poles, built according to designs and patents of Mr. J. L. Weller, superintending engineer of the Welland Canal, at St. Catharines, a number of the poles being in use in that city, Toronto and elsewhere in Ontario.

The pole developed by Mr. Weller is essentially the frustrum of a pyramid, built of concrete and reinforced by four steel rods running throughout its entire length. Rods of various lengths and increasing in cross-sectional area are arranged from the top to the bottom. This construction gives a tapering reinforcement, and, as the concrete and steel are in a constant ratio, the pole is tapering, as is the case in ordinary wooden pole structures.

CONCRETE POLE IN ST. CATHARINES.

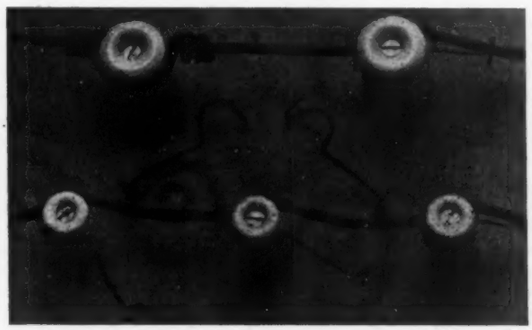
In the building of a pole there is used a wooden form, conforming in size to the estimated size for a given strain. As a matter of structural convenience, the cross section is made square with the corners chamfered off. The mold is built in sections of the most economic length for poles of a certain height. The bottom of the mold is first set in position, horizontally, on the ground. Then the sides, with the molding for the corner chamfers attached, are set to the required taper and held there by means of an occasional clamp on the outside. The top of the mold is left open and the concrete is given a smooth finish by troweling. The reinforcing rods are placed in when the mold is complete and are held in position, temporarily, while the concrete is being placed. The separate lengths are permanently joined together, but are not connected in any way at the top or bottom. The weights of the finished poles vary with the different strains they are required to withstand. For instance, a 30-ft. trolley pole to withstand 500 lbs. weighs about 1300 lbs., while a pole of the same length for 1000 lbs. will weigh about one ton. A 150-ft. pole to withstand a 4000-lb. strain weighs about 45 tons.

The cost of a concrete pole varies with the location; but, generally speaking, it is about one-third less than that of steel.

As compared with wood, the concrete pole is initially more expensive, but a fewer number of poles are required and there is no maintenance expense. There is also an increased safety from wind pressure. It is stated that a concrete structure has carried lines during a 60-mile gale under which a wooden line would have been demoralized. It is claimed in its favor that the concrete pole does not succumb to the attacks under which a wood or steel pole will fail. No paint, above ground, is necessary to improve its appearance, as the concrete is, in itself, of a pleasing gray color.

A Simple Wire Tie for Linemen.

The Economy wire tie as shown by the accompanying illustration is intended to substitute a ready means of attaching wire to knob insulators in place of the old way of tying. It is manufactured by Wilson & Drew Manufacturing Company, 70 West One Hundredth Street, New York City, which claims that one man can apply 15 of these ties while another is tying an insulator in the old-fashioned manner. It is estimated that the



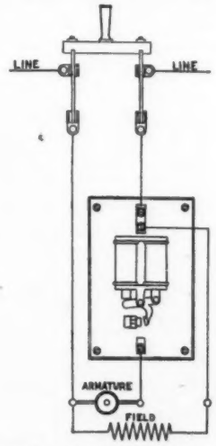
WIRE TIES.

cost of tying in the old way is from 1½ cents to 2 cents per insulator, and on this basis a very great saving may be effected.

The Economy wire tie can be instantly adjusted or removed without the use of tools. It is made of steel wire and, therefore, has sufficient spring to take up the slight slack which frequently exists in this type of wiring. The ties are japanned to prevent rusting. They are made at present in two sizes to conform with standard porcelain knobs, but it is proposed to make them of all sizes later on.

Automatic Motor Starter.

The circuit diagram shown herewith will serve to indicate the simplicity of an automatic motor starter recently placed



AUTOMATIC MOTOR STARTER.

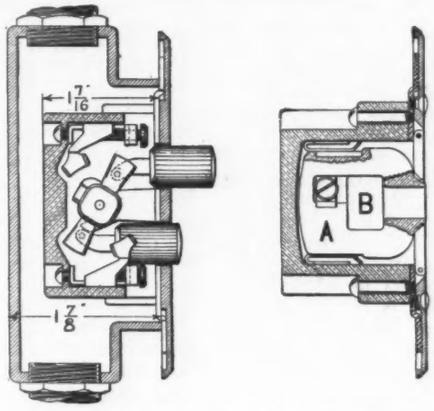
upon the market by the Monitor Manufacturing Company, Baltimore, Md. It consists of a single copper-and-graphite contact controlled by two magnets which are designed to cut out the starting resistance at the proper interval of time after the switch is closed. In the larger sizes the number of the steps on contacts controlling the resistance is increased so as to produce the correct acceleration. In every case the regulation of the starting resistance is effected entirely by the current passing to the motor, and no dash-pot or sliding contacts are used in connection with any part of the apparatus.

The starter is stated to be adapted for use in connection with motors operating pumps, fans, coffee mills, dumb waiters, paper cutters, individual shop tools, small air compressors, in fact any class of work requiring the frequent starting and stopping of electric motors, particularly when placed in the hands of unskilled labor.

Flush Switch, Plug and Receptacle.

Fig. 1 herewith illustrates what is stated to be the shallowest flush push-button switch on the market. It can be placed in a 2-in. partition without the use of a wood mat. The mechanism is equipped with a catch for locking when the proper button is depressed. A spring serves to open the switch with a very quick movement when the other button is depressed. The switch blades are of phosphor-bronze. Mica is used for insulation, while oil-tempered steel is used in the spring.

The flush plug and receptacle shown in Fig. 2 is constructed with a porcelain base only 1⅝ in. deep, yet it is claimed to be



FIGS. 1 and 2.—FLUSH SWITCH, PLUG AND RECEPTACLE.

extremely substantial. It is provided with heavy copper contacts, and the binding posts are located on opposite sides of the plug in such a way as to eliminate the danger of a short circuit. Both the switch and the receptacle are designed for 10 amperes at 250 volts, and will fit any of the standard wall boxes. These devices have been placed on the market by the Macken & Mayer Electrical Manufacturing Company, Buttonwood and Twelfth Streets, Philadelphia, Pa.

Allis-Chalmers Exhibit at Jamestown.

While the Allis-Chalmers exhibit at the Jamestown Exposition (Section No. 8, Machinery and Transportation Building) does not contain specimens of all lines of its products, these are of standard sizes and designs such as are used the country over for practical every-day service. This is particularly true of the electrical machinery shown and the Reliance engine which is well known to power users everywhere. Nearly half of all the Reliance engines thus far installed have been designed for connection to electric generators. The Allis-Chalmers type "A B" alternators, similar to the one on exhibition in Machinery Hall, are especially suited for comparatively small plants where a belted generator of not exceeding 150 kilowatt output is required. They are of the revolving field self-contained type.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Spring retail trade is backward because of the unusually late season, and tardy distribution of merchandise is also causing complaint of delay in mercantile collections; but there is confidence that most of the postponed business will be made up when the weather conditions become normal. Dealers purchased freely from manufacturers in anticipation of a record-breaking season, and deliveries are still coming from the mills and factories, shipments being facilitated by improved traffic conditions. Movement of grain is also liberal, attractive prices bringing out farm reserves, and the heavy freight business is shown by railway earnings thus far reported for April 14.2 per cent larger than a year ago. Manufacturers are active in all leading industries, most plants being operated full time, and the outlook in the steel business could hardly be brighter. Projected building operations promise a good demand for all materials, but numerous small labor disputes retard activity in this department. Crops are late in many sections because of cold weather, and prices of wheat and cotton advanced sharply. Snow's report pointed to April 1 estimates of yield of wheat being cut 100,000,000 bushels by damage and abandonment of winter-killed area. Export trade was checked by the advance, though offers are better, owing to poor reports from Europe, which also feels the effects of a backward spring. The pig-iron market was stronger and the volume of business in foundry iron has expanded and prices have advanced. Structural material is in heavy demand, but orders for steel rails for 1908 delivery are not coming in very well, though large inquiries are said to be pending. The market for copper was firmer, with European melters making fair demands, but American interests have been light purchasers. It is said, however, that consumers who have been holding off for a month or so in the hope of lower prices will be compelled to come into the market shortly. The closing sales were effected under contracts for July deliveries at 26 cents for lake, and 25 a 25¼ cents for electrolytic. The pressure for prime grades of casting is increasing. The market is strong at 24⅞ a 25 cents, for shipments in June. The factories which consume 75 per cent of the electrolytic copper worked up in this country report unchanged conditions as to demands for finished products. In the electrical engineering trades, the steady degree of increase that marked business at the opening of the year is going on in bookings of contracts for hydro-electric plants and for electric railway work. The better state of affairs in the money markets is enabling projectors of new electric power undertakings to place securities, the proceeds of which will be applied to the purchase of material wholly or in part of copper and brass. *Bradstreet's* reports 163 failures in the United States during the week, against 157 for the previous week, and 139 for the corresponding week of 1906. Imports of dry goods at the port of New York for the week were valued at $2,950,779, as against $3,154,629 for the previous week, and $2,707,933 for the corresponding week last year. The total value of the dry goods marketed was $2,935,998, as against $3,023,975 for the previous week, and $2,112,806 for the corresponding week last year.

COAL STORAGE UNDER WATER.—The *Mines and Minerals* for May makes note of the fact that about 1902, the Western Electric Company, after carefully investigating the question of uncertain coal supply due to strikes and other conditions beyond its control, decided to provide for storage of a considerable amount of fuel at its Chicago factories. As experience with coal bunkers at the Clinton Street plant showed very clearly that the Illinois coals, used by the company when stored in ordinary bins exposed to the air, suffered very materially from spontaneous combustion, it was decided to dig a hole in the ground at the Polk Street plant and store a large quantity of coal under water. This was carried out with satisfactory results inasmuch as no trouble has ever been experienced there with spontaneous combustion. When it was decided to provide for the storage of a large quantity of coal at the new plant at Hawthorne, Ill., it was decided to follow the same scheme. Accordingly a three-section storage pit was decided upon, to be built of concrete, covering a ground area of about 310 ft. x 114 ft. The pit, constructed, is arranged for filling with water so as to entirely cover all the coal that may be placed in it. Each section is approximately 15 ft. in depth and the whole pit has a capacity of approximately 10,000 tons, which is kept in reserve exclusively for emergencies. Three railroad tracks are carried on arched concrete piers running the entire length of the pit, thus dividing each of the three sections of the latter into four equal divisions. There are also two railroad tracks, one on each side outside the pit, running its entire length so that coal cars may be emptied into or loaded from the storage pits, while on any one of five railroad tracks. A locomotive crane, fitted with a grab bucket, is provided for taking the coal out of the storage pit and loading it into the coal cars. No provision is made for drying the coal before use as it is believed that the handling of the coal will result in its being dry enough for all practical purposes by the time it reaches the boilers.

SAN FRANCISCO POWER HOUSE.—One of the most distinctive of the numerous fireproof structures now in process of erection in San Francisco, is the power house now being built by Frank B. Gilbreth for the City Electric Company, a corporation formed by local men. The building will be along lines very similar to that recently completed by the same contractor for the Seattle Electric Company at Georgetown, Wash., the relation of the engine and boiler room being exactly the same. The structure will be of reinforced concrete and is planned to furnish space for two Parsons steam turbines, 2000-kilowatts capacity, with four batteries of water-tube boilers, which will furnish light, heat and power for various commercial purposes. The engine room will be 45 ft. by 70 ft. and the boiler room adjoining 84 ft. x 70 ft. with a height of 35 ft. In the engine room will be a traveling crane of 40 tons capacity. The design of the building will be such as to make possible its enlargement from time to time, the initial structure being erected with a view to its ultimate duplication. The foundation is placed on piles driven to hard pan 50 ft. below the street level. Requirements of the structure are that it shall be thoroughly fireproof, and, in so far as is practicable, earthquake-proof. With this in view, the structure is being designed along most conservative lines, the unit stresses, both in concrete and in steel, being well within the requirements of the San Francisco building laws. Work on the foundations is now well under way. At an estimated cost of $105,000 the building has been planned by and is being erected under the supervision of S. L. Napthaly, engineer for the company.

MOORE TUBES FOR LONDON.—On April 29 the Moore Electrical Company, of Newark, N. J., sent via the Hamburg-American liner "Deutschland" two men and apparatus for two installations of the Moore lamp in the largest automobile garage in Europe, located in London. This is especially interesting because it is the first foreign installation of the Moore system of tube lighting.

APPLIANCES FOR NAVY YARD.—The firm of Dossert & Company, 242 West Forty-first Street, New York City, have received an order from the Bureau of Yards and Docks, U. S. Navy Yard, Portsmouth, N. H., for 140 Dossert solderless 2-way joints, cable taps and standard terminal lugs for connecting underground cables of 1,000,000 and 500,000 circ mils.

ELECTRIC EQUIPMENT FOR NAVY YARD.—Bids will be received until June 1 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing two motor generator sets and accessories for the navy yard at New York, as per specification No. 1543. The estimated cost of the machines is $9,500.

NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., have furnished the plant of the Edison Sault Electric Company, Sault Ste. Marie, Mich., with a second 15-ton alternating current traveling crane.

HIGHER PRICES FOR ENGINES.—Owing to the continued advance in prices of raw materials, particularly pig iron,

manufacturers of all kinds of engines, we are informed, either have or are preparing to make a sharp advance in the prices of their products.

GENERAL ELECTRIC COPPER.—At its Bully Hill Mining & Smelting property, the General Electric Company is making preparations for largely increasing the output of the mine. The company has planned the construction of a railroad and a smelting and converting plant which will be able to handle 300 tons of ore a day and give the company a production of 10,000,000 pounds of copper a year.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was on the whole more activity in the stock market, but trading was restricted to comparatively few stocks. Union Pacific was the feature on indefinite rumors of a holding company which it is alleged will take over its investments in Southern Pacific and other stocks. The manipulation of this important security was very active, and was reflected in substantial advances in other parts of the list. Little attention was paid to the exceedingly good statement of the United States Steel Corporation's earnings for the March quarter, while the absence of any change in the dividend upon Steel common created no disappointment, it being fully expected that a conservative policy would be adhered to. The Steel stocks, however, developed some strength in sympathy with the action of the general market, and it was also noted that various other industrials were strong in an irregular fashion. Copper stocks were a decided feature, owing to the sharp advance in the London metal market. Amalgamated Copper and Anaconda both showed considerable strength, with not a little activity, and American Smelting was also favorably influenced, there being, moreover, an increase of interest in the various copper stocks traded in on the curb market. Electric stocks were generally firmer, and most of them closed the week at higher prices. Central and South American Telegraph made a net gain of 4 points, the last quotation being 138½. Chicago Union Traction, both common and preferred, made fractional gains. The curb market was generally quiet, with few changes in quotations. Following are the closing quotations of May 7:

NEW YORK.

	Apr. 30	May 7		Apr. 30	May 7
Allis-Chalmers Co.	11	11⅞	General Electric	148½	148
Allis-Chalmers Co. pfd.	30⅛	31¾	Hudson River Tel.	..	..
American Dist. Tel.	..	..	Interborough Met. com.	25	24½
American Locomotive	63½	63	Interborough Met. pfd.	59½	58½
Amer. Locomotive pfd.	106	108	Mackay Cos.	..	..
American Tel. & Cable	75	75	Mackay Cos. pfd.	69¼	..
American Tel. & Tel.	..	..	Marconi Tel.	..	..
Brooklyn Rapid Transit	59½	60¾	Metropolitan St. Ry.	..	..
Electric Boat	25	33	N. Y. & N. J. Tel.	..	..
Electric Boat pfd.	78	81	Western Union Tel.	82¾	82½
Electric Vehicle	..	..	Westinghouse com.	144	143¾
Electric Vehicle pfd.	..	..	Westinghouse pfd.	..	..

BOSTON.

	Apr. 30	May 7		Apr. 30	May 7
American Tel. & Tel.	122¾	124¼	Mass. Elec. Ry. pfd.	59	..
Cumberland Telephone	107½	..	Mexican Telephone	2¾	..
Edison Elec. Illum.	206	204	New England Telep.	121½	120
General Electric	149½	..	Western Tel. & Tel.	..	..
Mass. Elec. Ry.	..	16¼	West. Tel. & Tel. pfd.	..	..

PHILADELPHIA.

	Apr. 30	May 7		Apr. 30	May 7
American Railways	49¾	49½	Phila. Electric	8⅝	8½
Elec. Co. of America	10	10	Phila. Rapid Trans.	21¾	25⅜
Elec. Storage Battery	52½	52	Phila. Traction	94½	94
Elec. Storage Bat. pfd.	..	..			

CHICAGO.

	Apr. 30	May 7		Apr. 30	May 7
Chicago City Ry.	180	..	National Carbon	71	..
Chicago Edison	..	..	National Carbon pfd.	*111	..
Chicago Subway	17	17¼	Union Traction	..	..
Chicago Tel. Co.	130	127	Union Traction pfd.	..	..
Metropolitan Elec. com.	24	..			

*Asked.

NEW YORK LIGHTING.—It was stated last week by Mr. W. H. Knight, chief engineer of the Long Acre Electric Light & Power Company, a subsidiary corporation of the Manhattan Transit Company, that the company had floated $1,000,000 of 4 per cent thirty-year bonds, with the proceeds from which it was proposed to erect an electric power house at 120th Street and the Harlem River. The Long Acre Company has just obtained a court decision granting it rights in the electric conduits of Manhattan and the Bronx. Mr. Knight said the company was not yet ready to announce its financial plans, but that the bonds had been sold, with the inducement of a stock bonus for $1,000,000 cash. Following the decision of the Court of Appeals giving the Long Acre Electric Light & Power Company the right to use the conduits of the city, Mr. Edgar Van Etten has announced his resignation of the vice-presidency of the Boston & Albany Railroad to accept the presidency of the new company, and will move to New York City. Mr. Van Etten has been identified for years with the Vanderbilt interests. He will begin his new duties in the autumn. Attorneys for the Long Acre Company are busy preparing applications for space in the subways throughout the theater district preliminary to the extension of its service.

SAN FRANCISCO BONDS.—The United Railroads of San Francisco has authorized an issue of $5,000,000 first preferred stock, to bear interest at the rate of not less than 6 per cent per annum. This issue has been authorized to provide funds for new construction and improvements, and $1,500,000 is to be issued in the near future. All of this stock will be taken by the United Railways Investment Company, which owns all the stock of the United Railroads of San Francisco, as well as a controlling interest in the Philadelphia Company of Pittsburg. The combined statement of earnings of the companies controlled by the Investment Company for 1906, presented at the annual meeting of the stockholders yesterday, showed gross earnings of $23,785,596. The net earnings were $11,404,529, and the balance, after the payment of fixed charges and other deductions, including $1,595,627 for sinking funds, improvements and betterments, and after the payment of dividends on the preferred stock of the Philadelphia Company, was $3,548,615. Of this sum $877,145 represented earnings of the United Railroads of San Francisco, and $2,671,469 earnings of the Philadelphia Company. The proportion of earnings applicable to the United Railways Investment Company on the basis of its present holdings of Philadelphia Company stock was $2,821,975.

TELEPHONE CONVERTIBLE BONDS.—The underwriting syndicate for the $100,000,000 4 per cent convertible bonds of the American Telephone and Telegraph Company took up recently a fifth instalment, of 30 per cent, on the bonds. Four instalments, each of 10 per cent, had previously been paid, and the last instalment made 70 per cent, or $70,000,000, of the bonds for which the company has received payment. The bonds were taken by the syndicate a year ago at 94½, but have not found a ready market, the bond market having long been in a depressed condition. When, in January of this year, the company desired to place an issue of $25,000,000 5 per cent three-year notes, the syndicate as a condition of handling the issue asked for a reduction in the price of the bonds, and the company, it was announced at the time, lowered the price from 94½ to 91. Of the cash received from the $30,000,000 of the bonds now called, it is said, the American Telephone and Telegraph Company will use $20,000,000 for paying off the $20,000,000 5 per cent collateral trust notes maturing on May 1.

DIVIDENDS.—The directors of the Niles-Bement-Pond Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable May 15. The directors of the Pratt & Whitney Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable May 15. The United States Steel Corporation has declared a quarterly dividend of 1¾ per cent on the preferred stock and ½ of 1 per cent on the common stock. The Electric Properties Company has declared a dividend upon the preferred stock at the rate of 6 per cent per annum to April 30, 1907, from the date of the last dividend January 31, 1907, and from the date subsequent payments were received was declared on the preferred stock of the company payable May 10, 1907. Directors of the International Steam Pump Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable May 1. Directors of the H. R. Worthington Company have declared the regular semi-annual dividend of 3½ per cent on the preferred stock, payable May 1.

SALE OF WIRE PLANT.—Advices from New Haven, Conn., of May 3 say that an order to sell to the highest bidder the million-dollar plant of the National Wire Corporation of this city has been issued by Judge Robinson of the Superior Court. The receivers of the company, ex-Mayor Farnsworth and Stuart H. Hotchkiss, recommended the sale because of the heavy expense of the receivership. Judge Robinson ordered that the bids be opened on May 30. The receivers said to-night that they already have a dozen bids for the plant, one of which was from the U. S. Steel Corporation.

GENERAL NEWS

Construction News.

DORA, ALA.—Bids will be received by the committee on electric lighting until June 6, for the complete installation and erection of material and machinery only for a municipal electric lighting plant. Specifications can be procured from the chairman of the committee. The engineer in charge of the work is the Thornton Company, of Birmingham, Ala.

TALLADEGA, ALA.—The Talladega Electric Power Company finds that it will be impossible to make repairs on the Choccolocco power plant and at the same time furnish electricity for lamps of the city and consumers, and has decided to erect a temporary steam plant in the city. Machinery has been ordered for the temporary plant.

ARKADELPHIA, ARK.—Messrs. Fricby and Thrasher, of Malvern, Ark., have purchased the Arkadelphia telephone plant from H. J. Runyan, of Amity, Ark. They also own the Malvern system.

OZARK, ARK.—Work has commenced on the construction of the new electric lighting plant of the Altus Manufacturing Company.

PINE BLUFF, ARK.—City Attorney Coleman has filed a suit against the Pine Bluff Water & Light Company in the Jefferson County Chancery Court in behalf of the city. A receiver was asked for, and the Council also urges the annulment of the company's contract with the city.

STEPHENS, ARK.—Application has been made to the City Council by M. L. Milner for a franchise to erect an electric light plant in this city.

ALTURAS, CAL.—The Alturas Electric Light & Power Company is arranging to put in a larger water wheel in its plant on Pine Creek to meet the increased demand for electricity for motors and lamps in Alturas and for the new system being installed at Cedarville. The line from the plant to the Surprise Valley town is nearly 20 miles long.

LOS ANGELES, CAL.—The Board of Supervisors has sold an electric street railway franchise on Indiana Street to J. Harvey McCarthy for $100. This is to be an extension of the Boyle Heights line of the Los Angeles Company.

OROVILLE, CAL.—In order to transport sand for cement to the Great Western Power Company's plant at Island Bar, a six-mile electric railway will be constructed from the works to Cherokee, where the sand will be taken out of the old diggings at that point.

REDDING, CAL.—The third power house of the Northern California Power Company, located at Volta, which will increase the horse-power capacity of the company by 3000, was put into operation April 20. The new plant is entirely separate from the old. The company is constructing another large plant on Battle Creek, which when completed will have a capacity of 15,000 horse-power.

REDDING, CAL.—H. H. Noble, president of the Northern California Power Company, is constructing a plant on the Pitt River, in this county, for smelting iron ore by electric heat, of which a test will soon be made. Three transformers of 2000 horse-power will be required. The plant will cost about $100,000. If the test should prove successful, a plant capable of handling 500 to 1000 tons of ore per day will be installed at once.

RIVERSIDE, CAL.—Application has been made to the City Trustees by the Crescent City Railroad Company for a franchise for its proposed electric railway, which is to connect Riverside with the new cement plant now building by the Southern California Cement Company at West Riverside.

RIDGEFIELD, CONN.—The Legislature has passed an act amending the charter of the Ridgefield Electric Company, giving it permission to erect its poles and lines in different streets of the town.

UNIONVILLE, CONN.—The State Legislature has passed the bill authorizing the Union Electric Light & Power Company to increase its capital stock to $150,000.

WASHINGTON, D. C.—Bids will be received by Capt. John Stephen Sewell, Constructing Officer, U. S. Soldiers' Home, Washington, D. C., until June 3, for piping and electrical wiring within the power house and through the grounds and for refrigeration plants at the U. S. Soldiers' Home.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 21, 28 and June 11, to furnish at the various navy yards, naval supplies as follows: Schedule 706, magnet machine motors, motor-drive outfits, etc. Schedule 711, hydraulic jacks, etc. Schedule 759, electric fixtures, wire, etc. Schedule 767, water-tube boilers, etc. Schedule 782, induction motor, electric batteries, sheet copper, etc. Application for proposals should designate the schedules desired by number. E. B. Rogers, paymaster general, U. S. N.

KEY WEST BARRACKS, FLA.—Bids will be received until June 1 by the constructing quartermaster, U. S. A., Key West Barracks, for furnishing and installing electric lighting fixtures in the exchange and bowling alley at this post.

ATLANTA, GA.—The Georgia Railway & Light Company has amended its charter, authorizing the building of an extension of its line from East Point to Hapeville.

AURORA, ILL.—The Chicago Telephone Company is planning to place its wires underground in this city during the summer.

CHICAGO, ILL.—Bids will be received until May 21 by John J. Hanberg, commissioner of public works, for furnishing electric motors and controllers for electric power equipment of the South Halstead Street Bridge over the South Branch of the Chicago River.

VANDALIA, ILL.—The stockholders of the Vandalia Telephone Company have authorized an increase in the capital stock of the company from $6,000 to $15,000.

BLOOMINGTON, IND.—The Trustees of the Indiana University are asking for bids for the furnishing of boilers, stokers, an engine, electric generators and a quantity of electric fixtures for the new library building.

CRAWFORDSVILLE, IND.—The Trustees of the Crawfordsville municipal electric light plant have put in force an increased schedule of rates.

FT. BENJAMIN HARRISON, IND.—Bids will be received by Captain George H. Penrose, quartermaster, U. S. A., until June 1 for electricity and installing an electric lighting system, including a building for transformer, sub-station and lighting fixtures.

INDIANAPOLIS, IND.—The Park Board has decided to light Fall Creek Boulevard by electricity and has directed Superintendent Power of the parks to make plans for installing the lamps, of which 18 will be placed.

KNIGHTSTOWN, IND.—The municipal electric lighting plant is in need of extensive repairs, and it is proposed to issue $10,000 in bonds if approved by a referendum vote. The members of the City Council contend that prices for electric service must be greatly increased to make the plant self-sustaining.

LOGANSPORT, IND.—The entire wiring system of the municipal electric lighting plant will be overhauled and practically rebuilt in this city.

RICHMOND, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has accepted the terms of the city and will construct a line on North Twenty-Third Street, on which it will operate its freight cars. The company is planning a through freight service between Indianapolis and Columbus, Ohio.

DES MOINES, IA.—Contracts for the new electric light plant at the State Fair Grounds have been awarded as follows: Engine to Ball Engine Company, of Erie, Pa., for $1,670; boilers, Globe Machinery & Supply Company, of Des Moines, Ia., $2,195, and generator to Fort Wayne Electric Company, $1,667.

RED OAK, IA.—The Montgomery County Telephone Company has been reorganized, with a capital stock of $50,000. H. E. Deemer is president.

FORT LEAVENWORTH, KAN.—Bids will be received until June 1 by Captain J. E. Normoyle, quartermaster, U. S. A., for extending the electric lighting system at this post.

FRONTENAC, KAN.—The Home Heat, Light & Power Company, of Pittsburg, Kan., has taken over the franchise for lighting this city from the Pittsburg Electric Railway Company. A number of additional lamps will be installed.

WICHITA, KAN.—Preparations are being made for the reconstruction of the plant of the Wichita Gas, Electric Light & Power Company, now owned and controlled by J. O. Davidson and associates. The engine and boiler house will be rebuilt. A new boiler and a new 400-kw generator will be installed. The machinery for the new plant will cost about $100,000.

OWENSBORO, KY.—The Owensboro City Railroad Company is contemplating an expenditure of $50,000 during the coming summer in improvements to its system.

FRANKLIN, LA.—The City Council has adopted plans and specifications for a new municipal electric light plant twice the capacity of the present plant. The cost of the plant is estimated at $30,000.

MONROE, LA.—The water, light and traction committee of the City Council has recommended a reduction of 25 per cent in the rates for lighting. A power service will be established during the month of May.

BAR HARBOR, ME.—Preliminary surveys are being made by the Mount Desert Transit Company for its proposed electric railway, which will connect Ellsworth, Bar Harbor and other parts of Mt. Desert Island.

BALTIMORE, MD.—The Noel Construction Company has been awarded the contract by the Maryland Electric Railway Company for the erection of the sub-station at 708-710 West Lombard Street. It will be two stories high and 50 ft. x 150 ft.

CUMBERLAND, MD.—The Elkins Electric Railway Company is planning to extend its line from Elkins to Beverly and Belington, and also the construction of a power plant to cost about $100,000. The plant will be located at South Elkins and will supply electricity for lamps and motors in Elkins.

ADAMS, MASS.—The L. L. Brown Paper Company is installing another dynamo in its mill, to be used as an auxiliary to the one now in use. The machine was made by the E. G. Bernard Company, of Troy, N. Y.

BOSTON, MASS.—Sealed proposals will be received at the office of the Constructing Quartermaster, U. S. A., 263 Summer Street, Boston, Mass., until June 1, for the construction of a street lighting system and installation of electric lighting fixtures in double sets of N. C. S. O. Quarters, at Fort Strong, Long Island, Boston Harbor, Mass. Plans can be seen and specifications, blank forms and all information obtained at the above office. Capt. George L. Goodale is constructing quartermaster.

HAVERHILL, MASS.—Owing to a disagreement of the two branches of the City Council as to the method of awarding the contracts for city lighting, Mayor Wood, on May 1, ordered all street lighting discontinued, and notified the Haverhill Electric Company and the Welsbach Company to abandon their service. The Welsbach Company obeyed the order. The electric company declined to follow instructions and announced its intention of lighting its area, at least until the City Council meets in special session to act on the matter.

MATTAPOISETT, MASS.—The New Bedford Gas & Edison Light Company is contemplating extending its lines to this town to furnish electricity for lighting the streets and residences of the town.

NEW BEDFORD, MASS.—The Edison Electric Illuminating Company has submitted plans to the city engineer for placing its wires in underground conduits this year, which will involve an expenditure of about $150,000. A. E. Nelson is superintendent.

NORWOOD, MASS.—The electric light board has contracted with the Edison Illuminating Company to furnish electricity for lighting the streets for a term of seven years.

MORLEY, MICH.—A stock company composed of several local business men has purchased the water power property of William Hugh, Sr. The deal involves 100 acres along the Little Muskegon River, a grist mill and dam site in this village. It is expected that work on a new dam will commence in a few weeks. Charles Moore, Lyston Harding and William F. Turner and others are interested in the company.

MT. PLEASANT, MICH.—The plant of the Mt. Pleasant Electric Light Company has been purchased by E. O. Harris.

NEGAUNEE, MICH.—The Marquette County Gas, Light & Traction Company is contemplating extensive improvements and additions to its plant. A new boiler house is to be built in which four new automatic feed boilers will be installed. New coal conveyors will be installed and operated by the endless chain system. Orders will soon be placed for two new generators.

MINNEAPOLIS, MINN.—Steps preliminary to the establishment of a municipal electric light plant were taken at a meeting of the special committee appointed to consider the Dwyer ordinance. Instead of following the suggestion of Alderman James Dwyer and converting the two downtown water power pumping stations into electric generating plants, the committee decided to confer with William de la Barre, engineer and manager of the St. Anthony Falls Waterpower Company. Mr. de la Barre was quoted as saying that his company would soon have at its new plant, now under construction, 12,000 horse-power, which it would sell to the city for ¼ cent per kw-hour. He also stated that the company is erecting a $500,000 steam plant to supplement its water power at low stages of the river. The city engineer was requested to submit an estimate on the probable cost of wires, lamps and connections sufficient to light the city.

ROCHESTER, MINN.—G. L. Pillsbury, of St. Paul, is preparing plans for an electric light plant for Rochester.

ST. PAUL, MINN.—The Eaton Rapids Power Company, of Stearns County, has increased its capital stock from $133,000 to $233,300.

BROOKHAVEN, MISS.—Bids are wanted until June 4 for $15,000 in bonds, to be issued for the purpose of purchasing new and larger machinery for the water and light plant and for extension of mains. For further information address the Mayor.

LAUREL, MISS.—Frank Gardiner and associates have made application to the Board of Aldermen for a franchise for a street railway and electric lighting system.

VICKSBURG, MISS.—N. D. Smith and S. A. Jones, representing the Home Telephone Company, have filed an application with the City Council for a franchise to build a plant in this city.

JOPLIN, MO.—J. C. Amendt has petitioned the Council for a franchise to erect a power and heating plant.

HAVELOCK, NEB.—T. H. Wheeler is interested in the construction of an electric light plant.

TECUMSEH, NEB.—Bids will be received until May 14 by C. M. Wilson, city clerk, for $12,750 electric light bonds.

RHYOLITE, NEV.—The Rhyolite Heat, Light & Power Company has practically completed its power plant, and the town is now lighted with electricity for the first time. This plant will be operated with gasoline engines. The company contemplates increasing the capacity of the plant later on to furnish electricity for operating the mines in this section.

EAST ORANGE, N. J.—Edgar Williams, city clerk, writes that new bids will be received on May 13 for lighting the streets of the city by electricity according to plans on file with the city engineer.

MORRISTOWN, N. J.—Bids will be received until May 15 by the Mayor and Board of Aldermen for lighting the public streets for a term of five years, requiring about 50 arc lamps and 450 incandescent lamps. Nathaniel C. Toms is town clerk.

RUTHERFORD, N. J.—The committee appointed about a year ago to investigate the question of establishing a municipal electric light plant has submitted its report, in which it does not recommend the installation of a municipal plant.

SILVER CITY, N. M.—The New Mexico Light, Heat & Power Company is contemplating enlarging its plant in this city.

ALBANY, N. Y.—The State Railroad Commission has authorized the construction of the following electric railways: The Canandaigua Southern Railway Company running from Canandaigua to Atlanta, a distance of 33 1-3 miles; Utica Southern Railway Company, from Clinton to Hamilton, a distance of 26 miles; One Hundred and Forty-Fifth Street Railway, starting at the corner of One Hundred and Forty-Fifth Street and Lenox Avenue and running along One Hundred and Forty-Fifth Street to Broadway in New York City; Queens Borough Street Railway Company, from the junction of Franklin and Van Alst Avenues, along Van Alst Avenue to Winthrop Avenue, a distance of 1.1 miles, in the First Ward of the Borough of Queens.

CHENANGO FORKS, N. Y.—The stockholders of the Chenango Valley Telephone Company have decided to increase the capital stock of the company from $7,000 to $10,000.

COEYMANS, N. Y.—The State Commission of Gas and Electricity has denied the application of the West Shore Electric Company for a certificate of authority to install an electric lighting plant at Coeymans and to furnish electric service in Ravenna and New Baltimore. The commission finds that the territory proposed to be occupied, except the unincorporated village of New Baltimore, is already supplied by an ample and well constructed system furnishing service at a reasonable rate. The Upper Hudson Electric Company, which is supplying electricity in Coeymans and Ravenna was directed by the commission to install recording instruments, to renew its street series incandescent lamps at least four times a year, and to exercise greater care in the operation of its plant that a more satisfactory service may be obtained.

DEANSBORO, N. Y.—At a meeting at Deansboro on May 1 the Town Board of Marshall granted a franchise to the Oriskany Hydro-Electric Company to build a transmission line through the town. The company now has franchises giving it right of way from Norwich to Clinton.

FORT JAY, N. Y.—Bids will be received until June 1 by the constructing quartermaster, U. S. A., Governor's Island, New York Harbor, for furnishing and installing fixtures and watt meters in bachelor officers' quarters at Fort Jay.

NEW YORK, N. Y.—Bids will be received by J. W. Stevenson, commissioner of bridges, until May 16, for installing a ventilating system and electrical equipment for the Manhattan subway station of the Williamsburg Bridge. Blank forms, plans and specifications may be obtained at the office of the Department of Bridges, 13 Park Row, New York City. This is a readvertisement of the bids opened April 25.

ROCHESTER, N. Y.—The Rochester Railway & Light Company is constructing a conduit line on Mt. Hope Avenue from South Avenue to Clarissa Street into Wolcott Street and thence to the Genesee Valley Park and the city line, where a junction may be effected later on with the cables of the Niagara, Lockport & Ontario Power Company.

ROCHESTER, N. Y.—A bill has been introduced at Albany which is said to revive the lapsed rights of the Genesee Power Company. Under the present law the company has power to increase its capital stock at any time to not exceeding a final total of $20,000,000, and the company may construct a main dam or reservoir on the Genesee River near the village of Portageville for the purpose of improving the sanitary conditions of the Genesee Valley and to utilize the water power for the development of hydraulic and electric power. The amendment strikes out the limitation of the capital stock and modifies the provision that the crest of the spillway shall not exceed 118 ft., and asks power to construct and operate at all points below the location of the dam and "above the power dam now installed in the Genesee River at Mt. Morris," all necessary power dams, sluices, etc., and all necessary "constructions" and appliances for the development of power.

SPENCERPORT, N. Y.—The Niagara Falls Electrical Transmission Company, of Niagara Falls, has applied to the Board of Village Trustees for a franchise to erect its transmission lines in this village. The company has submitted a proposition to the board to install and operate 20 arc lamps for $1,400 per year.

DURHAM, N. C.—It is reported that the plant of the Durham Light & Power Company has been sold to New York capitalists for about $125,000.

DURHAM, N. C.—The Raleigh & Durham (N. C.) Passenger & Power Company, which proposes to construct a 28-mile interurban electric railway between Raleigh and Durham, has secured an amendment to its charter, moving the principal offices from Raleigh to Durham. B. S. Jerman is president of the company, and Jones Fuller, secretary.

FARGO, N. D.—W. R. Tucker, of Moorhead, is interested in a project to construct an electric railway to connect Fargo and Moorhead with Detroit, Minn., and the lakes in that vicinity. The length of the road is estimated at 50 miles, and will cost about $500,000.

VALLEY CITY, N. D.—The Council has under consideration the construction of a municipal electric lighting plant.

ATHENS, OHIO.—The Ross-Hull Electric Company, of Columbus, has secured the contract for enlarging and equipping the electric light plant at Athens.

CINCINNATI, OHIO.—The Factory Power Company has purchased property from the Milling Machinery Company and the Factory Colony Company on which it will erect a plant to supply electricity, light, heat, power, etc., to all the industries in the factory colony near Oakley.

CLEVELAND, OHIO.—The extension of the lines of the municipal electric lighting plant on Fulton Road, from Denison to Clark Avenue, has been ordered by President Springborn. Over 300 arc lamps are operated by the municipal electric lighting plant, which will be increased to over 400 this year.

COLUMBUS BARRACKS, OHIO.—Bids will be received until June 1 by Captain H. B. Chamberlin, constructing quartermaster, U. S. A., for installing an electric lighting system complete, and for furnishing electricity for illuminating and small motor purposes at this post.

GEORGETOWN, OHIO.—The citizens have voted to issue $12,500 in bonds to complete the electric light plant now under construction.

HAMILTON, OHIO.—Bids will be received by the Board of Public Works until May 16, for furnishing the necessary labor and material for enlarging, improving and repairing the municipal electric lighting plant. S. M. Goodman is president of the board.

WOOSTER, OHIO.—Application has been made to the City Council by the Martinsburg & Mt. Vernon Traction Company for permission to construct and operate a street railway over certain streets of the city. Charles A. Wieser is president.

THOMAS, OKLA.—The citizens have voted to issue $35,000 in bonds for water works and an electric light plant.

BAKER CITY, ORE.—The City Council has granted a 30-year franchise to William Pollman and associates of this city to build and operate an electric railway in this city, and also a line to Rock Creek and Haines.

ALLENTOWN, PA.—As a result of the law permitting electric railways to carry freight 20 miles of new railway lines will be built in Lehigh County. The South Bethlehem & Saucon Street Railway will be built, running from South Bethlehem to Center Valley. The Lehigh Valley Transit Company is to extend its system through the northern and western sections of the city. The management of the Allentown & Reading Traction Company is planning a new line from East Texas to Emaus, and thence to Lyons.

COLLEGEVILLE, PA.—The Governor has approved the application for a charter for the Perkiomen Valley Traction Company to build a line from Collegeville to Schwenksville. The company is capitalized at $75,000.

ELIZABETHTOWN, PA.—The application of the Elizabethtown & Deodate Electric Railway Company for a charter has been approved by the Governor. M. S. Hershey is president of the company, and the directors are: John E. Snyder, W. H. Lebkicher, S. C. Stecher, C. S. Manefair. The company is capitalized at $36,000.

GARRETSFORD, PA.—The charter application of the Garretsford & Delaware County Railway Company has been approved by the Governor. The company proposes to build an electric railway from Chester Heights to Llewellyn, a distance of 10 miles. The capital stock of the company is $100,000, and the directors are: George K. Lovell, Wilkes-Barre, president; John M. Garman, A. H. Bloom, B. C. Allen, E. J. Boyle, Thomas W. Hines and L. E. Waller.

LANCASTER, PA.—Articles of consolidation of the Stroever and Leland Electric Light Companies have been filed in the recorder's office. The new incorporation will be known as the Manheim & Mount Joy Electric Light Company. The capital stock is $10,000, and the directors are: J. H. McNeal, president; H. C. Case, L. N. Endebrock, all of Philadelphia; E. L. Baker and George R. Heisey, of Lancaster.

NEW WILMINGTON, PA.—The New Wilmington Telephone Company is preparing to make several extensions in its lines, and is in the market for wire, cross-arms and a general line of supplies.

SCRANTON, PA.—The Scranton Electric Light Company, the Suburban Electric Light Company, the Scranton Illuminating, Heat & Power Company, the Dunmore Electric Light Company and the Priceburg Electric Light Company, which were recently taken over by the American Gas & Electric Company, have been merged into one company, the corporate name of which is the Scranton Electric Company. The Lackawanna Light Company was not included in the merger, and for the present will operate as a separate company, although owned by the American Gas & Electric Company. Work has commenced on the improvements to the Washington Avenue power house. A large turbo-generator set and six boilers will be installed in the plant, the cost of which is estimated at $300,000.

TITUSVILLE, PA.—The Titusville Traction Company has authorized the extension of the company's lines to Cambridge Springs and to Oil City.

WOONSOCKET, MASS.—A controlling interest in the Woonsocket Electric Machine & Power Company on May 3 passed to Estabrook & Company, of Boston, Mass., representing a syndicate of New England capitalists. The Woonsocket Electric Machine & Power Company is capitalized at $500,000 and furnishes electric service to three street railway systems, besides supplying the municipal and commercial lighting in this city. Edward F. Allen, of Medford, Mass., was elected treasurer to represent the purchasing interests, and M. T. Wilcox, of Boston, Mass., general manager.

SPARTANBURG, S. C.—George E. Ladshaw, of the firm of Ladshaw & Ladshaw, of Spartanburg, writes that bids will be received about May 20 for the development of Van Patton Shoals on Enoree River for power purposes. A. B. Groce & Sons, of Duncans, S. C., are the promoters of the project.

GEDDES, S. D.—T. C. Pier, city auditor, writes that the citizens on April 16 voted to grant E. A. Boyd a franchise for a gas, electric light and heating plant.

CHATTANOOGA, TENN.—The Southern Skein & Foundry Company, a new industrial concern in this city, has purchased an alternating-current dynamo to run its plant. The company will generate its own electricity, and the different machines will be driven by individual motors.

LAWRENCEBURG, TENN.—Work will begin on the construction of water works and electric light plant as soon as the survey is completed. James T. Dunn is city secretary-treasurer.

MEMPHIS, TENN.—A large hydro-electric development on White River, in Arkansas, 120 miles from Memphis, will probably be undertaken during the summer by financial interests in this city. The development will include the construction of a reinforced concrete dam, a power house having a capacity of 15,000 kilowatts, and the construction of a transmission line about 125 miles long from the power house in Memphis. J. H. Watkins, vice-president, Bank of Commerce & Trust Company, of Memphis, is interested in the project, and J. A. Omberg, Jr., of Memphis, has supervision of the construction work.

GAINESVILLE, TEX.—The Gainesville Electric Company has filed an amendment to its charter increasing its capital stock from $50,000 to $100,000.

HEMPSTEAD, TEX.—The construction of an electric lighting plant in this city is now under consideration, and will probably be installed within a short time.

TOYAH, TEX.—A company has been formed by the business men of this place for the purpose of conducting an electric light and power plant.

PANGUITCH, UTAH.—Charles Hamblin, of Indianapolis, Ind., is interested in a company about to be formed to develop the water power of Colorado River for the lighting of Garfield County, and lighting and operating the machinery in the placer mines along Colorado, Grand and Green rivers.

PROVO, UTAH.—The Secretary of the Interior, at Washington, D. C., has placed a contract with the General Electric Company, of Schenectady, N. Y., for furnishing the electrical machinery for the power plant for the Strawberry Valley irrigation project, Provo, Utah, for $26,119.

MONTPELIER, VT.—The new Westinghouse 1500-kw turbo-generator set recently installed in the Pioneer plant of the Consolidated Lighting Company has been put in operation. Arrangements are being made so that the plants of the Consolidated Lighting Company and the Vermont Power & Lighting Company can be run together. The Consolidated Lighting Company expects soon to put the new machinery in its Bolton Falls plant in operation, which will carry the entire load of its lines and also furnish electricity to Vermont Power & Lighting Company. When the Bolton Falls plant is running at its full capacity the Pioneer plant will be used as an auxiliary plant.

HARRISONBURG, VA.—The United States Leather Company is having a preliminary survey made for an electric railway between Broadway and Lost City, which it proposes to build. The road will be 30 miles long.

LEAVENWORTH, WASH.—Guy A. Hamilton, town clerk, writes that all bids opened on April 23 for water works and electric light franchise have been rejected.

PORT ANGELES, WASH.—H. B. Kennedy, Fred A. Ballin and associates, of Seattle, have made application to the City Council for a franchise to operate a street railway system in this city.

SEATTLE, WASH.—Franchises for electric railways to Rainer Beach and Oxbow have been granted to the Seattle Electric Company by the Board of County Commissioners.

SEATTLE, WASH.—The City Council has granted the franchise, recently asked for by the Seattle, Renton & Southern Railway Company, to operate a street railway on certain streets in the city.

CHARLESTON, W. VA.—Preparations are being made by the Kanawha Valley Traction Company to extend its line to St. Albans.

GRAFTON, W. VA.—Plans have been made to install an additional engine, boiler and generator in the plant of the local brewery to furnish electrical power for operating the Grafton Street Railway system.

ROWLESBURG, W. VA.—H. R. Hollis, town recorder, writes that bids will be received until June 1 for a complete municipal electric light plant, including one 150-hp engine, a 200-hp boiler, a 100-kw transformer, with switchboard, etc.

GREENWOOD, WIS.—We have been informed that A. M. White is not now manager of the municipal electric light plant as reported in our issue of April 6. L. A. Thrapp has been appointed superintendent of the plant to succeed Mr. White.

KAUKAUNA, WIS.—The Green Bay & Mississippi Canal Company will rebuild the Kaukauna water power canal, which has been idle for several years, owing to litigation. It is understood that the canal will

furnish water power for a new electric power house for the interurban railway to be built from Fond du Lac to Kaukauna.

LA CROSSE, WIS.—The La Crosse Gas & Electric Company has purchased the property and holdings of the Wisconsin Light & Power Company. The officers of the La Crosse Gas & Electric Company are D. G. MacMillan, president; C. J. Felber, vice-president; P. M. Gelatt, secretary, and C. H. Williams, general manager.

FORT MACKENZIE, WYO.—Bids will be received until June 1 by Captain William D. Davis, quartermaster, U. S. A., for furnishing and installing fixtures, making service connections and installing watt-hour meters in buildings, and transformers for electric lighting at this post.

NEW WESTMINSTER, B. C.—The British Columbia Electric Railway Company is planning to make extensive additions to its property in this place. The new building to be erected will cost over $100,000.

VICTORIA, B. C.—A power plant to cost $40,000 will be built here in connection with the Canadian Pacific Railroad Company's hotel. Address, Hayter Reid, superintendent of hotels, Montreal, Que.

INDIAN HEAD, CAN.—The ratepayers will vote on a by-law to raise $10,000 for an extension to the electric lighting plant. Address, T. E. Donnell.

GALT, ONT.—Improvements to cost about $100,000 are contemplated for the Galt, Hespeler & Preston Railway. The road is to be double-tracked, new car barns built and a 750-hp engine will be installed in the power house.

LONDON, ONT.—The London Street Railroad Company will soon commence work on additions to its plant, which include the building of a $50,000 power plant.

TORONTO, ONT.—The Provincial Government has granted the Toronto Electric Light Company permission to increase its capital stock from $3,000,000 to $4,000,000.

TORONTO, ONT.—The Toronto Electric Light Company has applied to the City Council for permission to lay underground conduits on certain streets in the city.

FARNHAM, QUE.—Bids will be received until May 27 by A. E. Artois, mayor, for constructing an electric light plant in the town of Fairhaven.

CHIHUAHUA, MEXICO.—The large hydro-electric power enterprise projected on the Conchos River at La Joya is to be carried out now, according to a statement of Engineer Tye, of the Canadian Electric Syndicate, of Montreal, Can.

MEXICO CITY, MEX.—The Queens Consolidated Copper Company has recently placed an order with the General Electric Company for three large steam turbine units to be installed at Nacozari, Sonora, Mex.

MEXICO CITY, MEX.—The Mexican Sugar Refining Company is contemplating operating its plant by electricity and has placed an order with the General Electric Company for equipment for its mill, which includes two 300-kw generators to furnish electricity for operating 10 induction motors for operating the sugar centrifugals; also for transmission line and lighting equipment.

Company Elections.

MEDORA, ILL.—At a recent meeting of the Piasa Mutual Telephone Company the following officers were elected: G. R. Waggoner, president; George James, vice-president; George H. Clark, secretary; A. M. Stratton, treasurer.

MILWAUKEE, WIS.—At the annual meeting of the Milwaukee Independent Telephone Company held April 30 the following officers were elected: H. D. Critchfield, president; E. A. Wadhams and J. S. Van Nortwick, vice-presidents; C. J. Chapin, secretary; Howard Greene, treasurer. A contract has been made with the Century Telephone Company, of Buffalo, N. Y., for furnishing the material for the complete installation of a telephone system in this city. It is said that 15,000 telephones will be installed, which are to be ready for use June 1, 1908.

New Industrial Companies.

THE CROSS-LACHANCE ELECTRIC COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $5,000. The directors are: Samuel Cross, Hoboken, N. J.; F. A. Lachance, Brooklyn, N. Y.; W. L. Post, of Bronxville.

THE DAVIS TELEPHONE RATE ADJUSTING COMPANY, of Cleveland, Ohio, has been chartered, with a capital stock of $10,000, by H. L. Davis, W. G. McCullough, Isaac Sheets, Arthur Sheets and G. E. McCullough.

THE ELECTRICAL & MECHANICAL DEVELOPMENT COMPANY, of Asbury Park, N. J., has been incorporated, with a capital stock of $100,000, by O. H. Brown and others.

THE FEWKES-HENRY COMPANY, of Camden, N. J., has been incorporated, with a capital stock of $10,000, to manufacture electric motors. The incorporators are: Joseph T. Fewkes, Arthur J. Henry and M. D. W. Hirsh.

THE PEROXIDE ELECTRO-CHEMICAL COMPANY, of New York, N. Y., has been chartered, with a capital stock of $25,000. The directors are: Arnold Stern, J. V. Nevin and W. H. Hanford, of New York, N. Y.

THE READ & HOWE COMPANY (electrical contractors), of Bangor, Me., has been chartered, with a capital stock of $10,000. The officers of the company are: A. W. Read, president; B. G. Brackett, treasurer; E. P. Howe, clerk, all of Bangor, Me.

New Incorporations.

ALBERTVILLE, ALA.—The Sand Mountain Electric Company has been organized with a capital stock of $50,000. The company proposes to construct a power plant at Short Creek, near Albertville, to furnish electricity to towns and cities within a radius of 50 miles and to build and operate a railway from Gadsden to Scotsboro. The incorporators are: Leon C. McCord, E. O. McCord, Rena B. McCord, G. M. E. Mann, W. E. Snead and J. B. Roberts.

REDLANDS, CAL.—The Redlands Central Railway Company has filed articles of incorporation, with a capital stock of $100,000, to build an electric railway from Redlands to Riverside, with a branch to Craftonville. The incorporators are: O. T. Higgins, E. S. Graham, F. E. Sanford, A. G. Hubbard and J. H. Fisher.

SAN FRANCISCO, CAL.—The Fagan Electric Company has been incorporated, with a capital stock of $25,000, by W. W. Hicks, W. A. Fagan and F. J. Devlin, of San Francisco.

CHICAGO, ILL.—Articles of incorporation have been filed for the Illinois & Western Railway Company, with a capital stock of $5,000, to construct an electric railway from East Dubuque, Ill., to Dubuque, Ia., thence to Galena, Ill. The directors are: Conrad H. Poppenhusen, Evanston, Ill., and Joseph L. McNab, of Evanston; Edward T. Fox, Michael Gesas and William G. Hamilton, of Chicago.

PEORIA, ILL.—The McKinley Syndicate has secured a license from the Secretary of State to incorporate the Chicago, Ottawa & Peoria Railway Company. The company proposes to construct an electric railway from Chicago to Peoria, with a branch to Peoria and thence to Princeton. The capital stock of the company is $500,000 and the directors are: H. E. Chubbuck, Ottawa; W. H. Carnahan, C. A. Wright, Charles Zilly and George M. Mattis, all of Champaign. The principal office of the company is at Champaign.

SPRINGFIELD, ILL.—The St. Louis, Terre Haute & Quincy Traction Company has been incorporated, with a capital stock of $25,000, to construct an electric railway from Terre Haute to Quincy, with a branch from Shelbyville to Venice. The incorporators are: Edward Yates, of Pittsfield; Peter Chase, of Decatur; H. T. Willson, of Virden; H. C. Simons, of Virden, and E. E. Barclay, of Springfield.

FORT WAYNE, IND.—Articles of incorporation have been filed for the Toledo & Ft. Wayne Electric Railway Company, with a capital stock of $100,000. The company also proposes to furnish electricity for lighting, heating and power purposes along the line.

INDIANAPOLIS, IND.—The Chicago, Indianapolis & Terre Haute Electric Railway has filed articles of incorporation with the Secretary of State. The capital stock is put at $50,000. The promoters and directors are: Daniel W. Bowlen, Chas. M. Killer, F. M. Strong, R. F. Stewart and Simeon Lofton.

OLDS, IA.—The Mutual Telephone Company has been incorporated with a capital stock of $14,000.

SEARSPORT, ME.—Articles of incorporation have been filed for the Searsport Electric Company, with a capital stock of $50,000, and the following officers: Amos Nicholls, president and treasurer, and D. C. Nichols, clerk, both of Searsport.

ASHLEY, MICH.—The Ashley Rural Telephone Company has been organized, with a capital stock of $10,000, and the following officers: O. N. Fairbanks, president; Henry Kennett, secretary, and George Mitchell, treasurer.

CARO, MICH.—Articles of association have been filed for the Cass City Telephone Company by J. C. Corkins and others. The company is capitalized at $5,000.

MISSOULA, MONT.—Articles of incorporation have been filed with the Secretary of State by P. J. Shannon, O. Blood, J. L. Humble, E. O. Lewis and W. W. McCracken for the Missoula & Bitter Root Traction Company, which proposes building an electric railway from Missoula to Hamilton, at an estimated cost of $1,500,000. The capital stock of the company is $40,000.

TRENTON, N. J.—The Chicago Securities Corporation has been incorporated at Trenton, N. J., with an authorized capital of $1,200,000. The purpose of the company is to acquire the stock and securities of other corporations and to produce and deal in natural and artificial gas and electricity. The incorporators are H. O. Coughlan, John O. Turner and Felix Ingold, all of Jersey City.

BROOKLYN, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Wythe Electric Light, Power & Warehouse Company, with a capital stock of $300,000. The directors are: Arthur Iselin, Lincoln Cromwell and G. H. Blish, of New York, N. Y.

CORTLANDVILLE, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Cortland County Lighting Company, with a capital stock of $250,000. The directors are: E. J. Hatch, New York; W. J. Bagnell and L. B. Grant, of Brooklyn.

RED HOUSE, N. Y.—Articles of incorporation have been filed for the Seneca Independent Telephone Company by Fred W. Gates and others. The capital stock of the company is $10,000.

DILLSBORO, N. C.—The Dillsboro & Sylva Electric Light Company has been incorporated, with a capital stock of $10,000, by J. C. Fisher and others.

RAMSEUR, N. C.—Articles of incorporation have been filed for the People's Telephone Company, with a capital stock of $20,000. The incorporators are E. Watkins and others.

LIDGERWOOD, N. D.—The Lidgerwood Rural Telephone Company has filed articles of incorporation, with a capital stock of $25,000. The incorporators are: Louis J. Christensen, John J. Mathews and Mary C. Christensen, all of Lidgerwood.

COLUMBUS, OHIO.—The Columbus, Marysville & Bellefontaine Railway Company has been incorporated, with a capital stock of $25,000, by R. P. Hankey, G. W. Meeker, Emmitt Tompkins, Eugene Gray and W. A. France. The men behind the new company are interested in the Findlay-Marion Railway & Light Company, and propose to construct an electric railway from Columbus to Marysville and Bellefontaine.

EL RENO, OKLA.—The Oklahoma City, El Reno & Southeastern Interurban Railway Company has applied to the Secretary of State for a charter for the purpose of building a street railway system in El Reno and interurban lines. The incorporators are J. W. Smith, Fred Ehler, of Hennessey, and W. R. Blackburn.

OKLAHOMA CITY, OKLA.—The Twin Creek Telephone Company has been incorporated, with a capital stock of $5,000, by J. P. Petrasek and others.

OKLAHOMA CITY, OKLA.—A charter has been issued to the Oklahoma City Rapid Transit Railway Company to build an interurban line between Oklahoma City and Tecumseh. The company is capitalized at $2,000,000, and the incorporators D. D. Klapp, E. W. Milburn, C. M. Cissna and W. E. Powell, and others of Tecumseh.

SICKLES, OKLA.—The Sickles Telephone Company has been incorporated by E. H. Noble and J. Winterringer, of Binger, and L. E. Teter, of Lookeba.

ALLENTOWN, PA.—The Franklin & Moyamensing Electric Street Railway Company has been organized and will apply for a charter to build an electric line from Weissport to Bowmanstown and Millport. The incorporators are: A. P. Berlin, John T. Semmel, Dale Craig, H. J. Bretney and T. J. Fretz.

ELLWOOD CITY, PA.—A charter has been granted at the State Department to the Belt Line Street Railway Company, of Ellwood City, with a capital of $25,000, to build four miles of line over the more important highways of the city. The directors are: George W. Young, of Pittsburg, president; J. E. Fitzgerald, William Trinkle, Frank H. Kuhn, and Oscar C. Glosser.

ELIZABETH, PA.—The Mentor Street Railway Company has been chartered, with a capital stock of $60,000, to build a 10-mile line from Elizabeth to Webster, Pa. The directors are: D. B. Neagley, president; E. L. Kern, J. K. Neagley, Geo. M. Kain, N. F. Bicking, all of Pittsburg.

NEW CASTLE, PA.—The Beaver Falls, Youngstown & New Castle Railway Company has been incorporated by N. B. Duncan, Jordan Johnson, George B. Nye and others.

TURTLE CREEK, PA.—The Ft. Pitt Light & Power Company has been incorporated, with a capital of $10,000, by B. S. Hare, M. R. Chulbuck and E. L. Vandermast, of Pittsburg.

NASHVILLE, TENN.—The Home Telephone Company has been organized with R. F. Cooper as president. The new company will be required to place its wires underground in certain districts of the city.

ABILENE, TEX.—The Abilene Street Railway Company has been incorporated, with a capital stock of $100,000, by J. M. Wagstaff, George L. Paxton and others.

EAGLE LAKE, TEX.—The Eagle Lake Water, Light & Gin Company has been incorporated, with a capital stock of $25,000, by B. L. Vineyard and others.

SAN ANTONIO, TEX.—The Dehymel Water Light Company has been incorporated with a capital stock of $35,000 by J. J. Donaldson, G. M. Magill, C. Schouermeyer, F. O. Dehymel and David Lehr, all of San Antonio.

SWEETWATER, TEX.—The Sweetwater Ice, Light & Water Company has been incorporated, with a capital stock of $5,000, by E. Daniel and others.

WELLINGTON, TEX.—The Union Telephone Company has filed articles of incorporation, with a capital stock of $2,000. The incorporators are J. T. Littlefield and others.

WICHITA FALLS, TEX.—The Wichita Falls & Northwestern Telephone Company has been incorporated, with a capital stock of $10,000, by R. E. Huff, C. C. Huff and William McGregor.

ASHEVILLE, VA.—The Asheville & Henderson Railway Company has been chartered, with a capital stock of $750,000, to build a line from Asheville to Hendersonville, a distance of 20 miles. C. F. White, of Skyland, is the principal stockholder.

ONANCOCK, VA.—The Chesapeake & Atlantic Light & Power Company has been chartered to build an electric railway from Wachapreague to Hancock. The capital stock of the company is $100,000, and the directors are: E. T. Powell, president; John W. Kellam, M. R. Bullman, A. J. McGrath, Benjamin T. Gunter, L. J. Savage and others. C. C. Long, of Tazeville, Va., has been asked to take charge of construction of the road.

WENATCHEE, WASH.—Articles of incorporation have been filed with the Secretary of State for the Valley Power Company, with a capital stock of $100,000.

GRAND RAPIDS, WIS.—The Wisconsin Valley Electric Railway Company, with a capital stock of $25,000, has been incorporated. George A. Whiting is one of the incorporators.

MADISON, WIS.—Articles of incorporation have been filed with the Secretary of State for the Southern Wisconsin Light & Traction Company. F. W. Montgomery, president of the Madison Interurban Traction Company, is one of the incorporators.

MILWAUKEE, WIS.—The Pneumatic Power Development Company has been incorporated, with a capital stock of $25,000, by John Neumaker and others.

MILWAUKEE, WIS.—A company has been formed to construct and operate an electric railway from Milwaukee to Fond du Lac by way of Manitowoc and Sheboygan. The company is to be known as the Milwaukee & North Shore Railway. W. C. Stone, of Watertown, is one of the incorporators.

ORANGE, WIS.—Articles of incorporation have been filed for the Badger Telephone Company by G. B. Bailey and others. The company is capitalized at $10,500.

PHILLIPS, WIS.—Articles of incorporation have been filed for the Price County Telephone Company by Roy L. Winchester, E. Vincent Covey, Ella V. Winchester and L. A. Covey. The company is capitalized at $10,000.

PORT WASHINGTON, WIS.—The Port Washington Telephone Company has been incorporated with a capital stock of $5,000 by W. B. Krause, Henry Hemes, A. H. Kuhl, J. W. Krause and J. E. Uselding.

WAUSAU, WIS.—The Beans Eddy Power Company has been incorporated, with a capital of $36,000, to construct a dam at Beans Eddy to develop and transmit power to Stevens Point, Wausau and other points in this vicinity. The incorporators are: P. C. Hart, Charles E. Guenther and H. G. Flieth.

LOUISVILLE, QUE.—The Commons Railway Committee on April 11 passed a bill to incorporate the St. Leon Railway Company, with a capital stock of $100,000, to construct an electric railway from Louisville to Three Rivers. The incorporators are: G. Ruel, George T. MacDonald, L. W. Mitchell, F. C. Innestry and M. Howard, of Toronto.

Legal.

MUNICIPAL OWNERSHIP IN DETROIT.—The Michigan Supreme Court on May 1 decided that the city of Detroit cannot build street railway tracks to be leased to an operating corporation. The council of that city in 1905 ordered the Department of Public Works to lay tracks on several streets and appropriated $10,000 to begin work. A question as to the legality of this action was raised and an injunction was sought to restrain the city. The Wayne Circuit Court granted the writ, sustaining the assertion that the city had not the right to do the work, and the case was carried to the Supreme Court.

STOCKHOLDER'S RIGHT TO INSPECT BOOKS OF CORPORATION.—A stockholder in a street railway company has the right to examine the books of the corporation, provided he does so at reasonable times, and so as not to needlessly disturb the company or interfere with the transaction of its business. And, to aid him in making such examination, the stockholder may make use of a stenographer, for the purpose of taking minutes of such parts of the records as he desired, or of an expert accountant. State vs. St. Louis Transit Company, St. Louis Court of Appeals, 100 S. W. Rep. 1126.

SECOND-HAND EDISON LAMP RULING.—A permanent injunction has been issued by the United States Circuit Court, District of New Jersey, restraining William F. McKeon and Joseph Conning, of Newark, N. J., from selling second-hand incandescent lamps unless marked "Used and Second Hand." The decision, signed by Judge Cross, ends a litigation between the General Electric Company and the defendants, which has extended over a period of three years. Similar suits were instituted, one against Edward Mills, proprietor of the Newark Electrical Supply Company, and the other against Frederick F. Chase, proprietor of the Lamp Supply Company of New York. Neither of these parties defended, and decrees were therefore taken against them by default.

PATENTS FOR ELECTRICAL IMPROVEMENTS HELD INVALID FOR ANTICIPATION.—In an action for the infringement of the Burke patent, No. 631,518, issued Aug. 20th, 1899, for improvements in an electric motor or generator, consisting of a frame or cradle for the armature to rest in, with bearings at the two ends of the axle, for the purpose of preserving a perfect alignment and also for infringement of the Bliss patent, No. 669,574, covering a frame for electric motors, issued March 12th, 1901, it is held by the United States Circuit Court of Appeals that both patents are void for anticipation. The decision reverses the holding of the Circuit Court for the Southern District of New York, which was to the effect that the patents were valid and had been infringed. The Burke patent was held to have been anticipated by certain Thomas-Houston motors running elevators in the city of Boston, Mass., which were installed prior to the date of Burke's invention. New

England Motor Company vs. B. F. Sturtevant Company, 150 Fed. Rep. 131.

RIGHT TO CONSTRUCT AND MAINTAIN CONDUITS UNDER SIDEWALKS.—The Allegheny County Light Company was incorporated under the laws of the State of Pennsylvania in 1880. Assuming that it had the right to furnish electric light to the public, the city of Pittsburg, by ordinance in 1881, authorized it to "erect and maintain poles and wires for the purpose of conducting electricity to be used for lighting purposes," etc. But the company was not actually authorized to supply electricity under its original charter and thereafter it surrendered the original charter and took out another charter under the act of 1889 for the purpose of supplying electricity for light, heat and power. The question then arose as to whether the company had the right to construct its conduits under the streets. It was held that the ordinance of 1881 gave the company that right and that it was not necessary to obtain a renewal of the municipal consent after the taking out of the new charter. The fact that the ordinance of 1881, it was held, could not be construed to mean that the right to lay conduits was prohibited. Further, the act of 1889, under which the new charter was granted, expressly provided that the company might "alter, inspect and repair its system of distribution." And in placing conduits under the sidewalks of the city the company was merely altering its system and was acting entirely within its rights. Allegheny County Light Company vs. Booth, Supreme Court of Pennsylvania, 66 Atl. Rep. 72.

APPEAL FROM ORDER DIRECTING TELEPHONE COMPANY TO RESTORE CONNECTION.—The Rural Home Telephone Company operates a number of telephone exchanges in Daviess County, Kentucky, and the Kentucky & Indiana Telephone & Telegraph Company operates an exchange in Owensboro, and has other long distance connections. The two concerns had entered into some kind of an agreement by which they effected a physical connection between their systems for the mutual exchange of traffic among their patrons. Subsequently another system entered the field at Owensboro, the Cumberland Telephone & Telegraph Company. Later the Cumberland and the Rural companies agreed upon an interchange of business and the Rural attempted to cut loose from its former associate, the Kentucky & Indiana Company, so as to divert all the business of the Rural's patrons over the lines of the Cumberland. The Kentucky company thereupon brought its suit in equity and succeeded in having the threatened severance enjoined. The connection between the Rural and the Kentucky companies was maintained, but the former refused to send any messages over the lines of the latter company. The Rural was then adjudged to be in contempt of court and was ordered to restore the service as it existed originally and to give its subscribers connections upon the lines of the Kentucky company. From this order the Rural company attempted to appeal, but it was held that the appeal could not be taken for the reason that the order was not final. Rural Home Telephone Company vs. Kentucky & Indiana Telegraph & Telephone Company, Court of Appeals of Kentucky, 100 S. W. Rep. 847.

THE DOWNES PATENT, NO. 534,785, FOR A PROCESS FOR APPLYING ASBESTOS INSULATION TO ELECTRICAL CONDUCTORS HELD NOT INFRINGED.—The United States Circuit Court of Appeals has decided that patent No. 534,785 for an improvement in methods of and apparatus for insulating electrical conductors, invented by Louis F. Downes, of Providence, R. I., is not infringed by a device used by the Teter-Heany Development Company. The process patented by the plaintiff, Downes, consisted of (1) coating the wire with a suitable adhesive substance; (2) winding the wire with an asbestos yarn or strand; (3) brushing or carding the asbestos yarn or strand, while on the wire, in order to raise the nap and lay the fibers in one direction; (4) compressing or compacting the asbestos after brushing or carding; and (5) applying, if desired, a suitable waterproof coating or shield. The process used by the defendant, the development company, did not include the third step of the plaintiff's process, which was the feature upon which the patent depended, the other steps in the process being old to the art. The difference between the two processes lay in the fact that the plaintiff applied the asbestos covering to the wire and then carded it, while the defendant carded the asbestos and then applied it to the wire. The defendant accomplished the same result as the plaintiff by placing a quantity of flocculent asbestos in a hopper and then drawing from the hopper by means of a toothed belt fibers of asbestos, which were laid longitudinally upon the belt and conveyed by it to the rotating wire which had been coated with an adhesive substance. It was held that the defendant's process was not an infringement. Downes vs. Teter-Heany Development Company, 150 Fed. Rep. 122.

Obituary.

PROF. A. H. SMYTHE.—Prof. Albert H. Smythe, noted Shakespearean authority, died in Philadelphia on May 4, of Bright's disease. He was born in that city on June 18, 1863, the son of William Clarke and Adelaide Sophie Smythe. He was graduated from Johns Hopkins in 1886, when he became professor of English language and literature at the Central High School, a place he held until his death. He was a member and curator of the American Philosophical Society. He was appointed representative of the United States by President Roosevelt at the unveiling of the monument to Franklin in Paris, erected by Banker Harjes. He was the author of several books, but his "Life and Works of Benjamin Franklin," in ten volumes, 1905-6, made him known widely.

MR. N. PARKS.—Mr. Nathaniel Parks, a pioneer in electric experiments and inventions, died at his home in Deansboro, Oneida County, N. Y., on April 30. He was 82 years old. When young, he sank several miles of wire in the Shenango Canal, near Bouckville, and to these wires attached telegraphic instruments for the purpose of testing the practicability of a water cable. The information thus gathered was increased by experiments made on a more extended scale in the Harlem River by Mr. Parks, in company with Cyrus W. Field. Mr. Parks had an important part in perfecting the arrangements for laying the first Field submarine cable, and transmitted some of the first messages over it. He devised many electrical appliances, but failed to benefit in a financial way from his inventions.

Personal.

MR. FARLEY OSGOOD, of New Milford, Conn., who for the past three years has been general manager of the New Milford Power Company, has resigned his position to take effect June 1.

MR. GEORGE P. HUTCHINS has moved from 120 Liberty Street to the Bristol Building, 500 Fifth Avenue, New York. His telephone number has been changed from 1842 Cortlandt to 2517 Bryant.

MR. HARRY SMITH, who has for several years past been in charge of all the Government telephone lines in the Great Lakes and Pacific Coast districts, with headquarters at Green Bay, Wis., has been transferred to the Atlantic Coast, with headquarters at Atlantic City, N. J.

DR. A. G. BELL.—Advices from London state that on May 2 Oxford University conferred the honorary degree of Doctor of Science on Prof. Alexander Graham Bell, Regent of the Smithsonian Institution at Washington and inventor of the telephone.

MR. K. SOGAWA, hydraulic engineer of the Government of Formosa, is on a visit to this country to study some of the more recent hydro-electric plants. Upon his return work will be commenced on a 1000-kw and a 3000-kw hydro-electric plant in Formosa.

PROF. ERNEST RUTHERFORD, of the McGill University faculty of applied science, whose work in the field of radio-activity is well known, has just received from that institution the honorary degree of doctor of laws at the convocation exercises.

MR. F. W. LAWRENCE, of New York City, N. Y., has been appointed general superintendent of the Chattanooga Electric Light Company, Chattanooga, Tenn. The business of the company has grown to such an extent that it was necessary to create this office to handle it.

MR. HARVEY B. FLEMING, chief engineer of the Chicago City Railway Company, has been appointed a member of the new supervising board of traction engineers of Chicago, Ill., to represent the Chicago City Railway Company on the board provided for by the new traction ordinances.

MR. HENRY FLOY, the consulting electrical engineer, St. Paul Building, New York City, has just returned from an extensive trip in Mexico, made in the interests of the Rascon Manufacturing & Development Company, and its proposed hydro-electric plant and long distance transmission in that country.

MR. R. M. SUMMERS, formerly with Eastmans Packing Company, of New York City, and later with Swift & Company, South Omaha, Neb., has been appointed general superintendent of the Water, Light & Transit Company, at Carrollton, Mo., the position of general manager being abolished. Mr. Summers assumes charge of the whole system. His past experience fully qualifies him for the new position.

MR. GEORGE BULLOCK, president of the United Gas & Electric Company, of New York, N. Y., has been elected president of the Lancaster County Railway & Light Company, succeeding Mr. W. W. Greist. Mr. Charles E. Griscom, of Philadelphia, Pa., has been elected vice-president of the company, and Mr. M. W. Dodge, secretary and treasurer. The control of the company has recently passed into new hands.

MR. IRA A. McCORMACK, heretofore manager of the Grand Central Station and general manager of the electric division of the New York Central & Hudson River Railroad, has been appointed assistant to the general manager of the road, having charge of matters pertaining to electric operation of the road. Mr. A. R. Whaley has been appointed general manager of the Grand Central Station and general superintendent of the electric division of the company to succeed Mr. McCormack.

MR. C. M. CLARK, of Philadelphia, Pa., chairman of the executive committee of the Portland Railway, Light & Power Company, of Portland, Ore., has been elected as president of the company to succeed the late Mr. Henry Walton Goode. Mr. Clark will reside in Philadelphia, Pa., and the active management of the property will be vested as heretofore, with Mr. F. I. Fuller in direct charge of the railway system and Mr. F. G. Sykes in charge of the electric lighting and power branches.

MR. F. P. FISH will remain active in work in the electrical field in spite of his resignation from the presidency of the American Telephone & Telegraph Company and the Western Telegraph & Telephone Company. Aside from his membership hitherto in the directorates of thirty-seven telephone companies, he is also a director of the City Trust Company, Edison Electric Illuminating Company of Boston, the General Electric Company, New England Trust Company and the Old Colony Trust Company. He will probably retain all but the telephone directorships.

DR. G. F. KUNZ.—Through the French Consul-General the decoration of Chevalier of the Legion of Honor was conferred last week upon Dr. George F. Kunz, of this city, in recognition of his scientific work. Dr. Kunz, who is head of the precious-gem department at Tiffany's, is a native of New York and is 50 years old. He has received honorary degrees from Columbia and the University of Marburg, has done special geological research work for the Government, and is president of the New York Mineralogical Club, as well as vice-president of the American Institute of Mining Engineers. In 1889 he received from the French Government the decoration of Officier d'Instruction Publique, and he is an honorary member of various foreign scientific societies. His book on North American gems is recognized as authoritative. He has taken deep interest in radium researches and has made a splendid collection of meteorites for the Natural History Museum of New York City.

Trade Publications.

AIR HEATERS.—The Green Fuel Economizer Company, Matteawan, N. Y., has issued a bulletin devoted to its air heater by means of which it is claimed 15 per cent of the coal used in a steam generating plant may be saved.

GAS ENGINES.—The Jacobson Machine Manufacturing Company, Warren, Pa., has issued in connection with its 1907 catalogue of gas engines and compressors an unusually complete "Engineer's Handbook," which is in reality a practical treatise on the gas and gasoline engine. In addition to discussing the properties of gas and giving instructions for the operation of gas and gasoline engines, the catalogue contains much information of value to engineers.

W. N. MATTHEWS & BRO., 219 North Second Street, St. Louis, Mo., have just issued a net price book of their specialties for distribution to the trade. The idea is to give the buyer quick and convenient information as to all their apparatus, and thus to eliminate, as far as possible, any inquiries by correspondence, hence simplifying any transaction from the start. The book is printed in two colors and by two runs of the press.

ELECTRIC FANS.—For the cover page of its catalogue No. 315 devoted to electric fans, the Sprague Electric Company has selected an illustration in colors of a hand-painted lady's fan on which appears the head of a beautiful girl whose golden locks are blown in attractive curves about her face. The artistic appearance of the catalogue will cause it to be treated with consideration by those for whom it was intended, the users of electric fans in the offices and the homes.

ELECTRIC TOOLS.—An indication of the extent to which electricity is employed as the immediate agent for operating portable tools is given in Catalogue No. 21 of the Chicago Pneumatic Tool Company, Chicago, Ill., which is a 60-page publication devoted exclusively to air-cooled portable electric tools. Descriptions are given of electric drills, grinders and hoists. These tools are operated by either direct or alternating current motors, the latter being of the polyphase induction type.

THE ROBINS CONVEYING BELT COMPANY, of 13 Park Row, New York, has just issued an interesting four-page leaflet describing the installation of a package conveyor system in the new store of B. Altman & Company, Fifth Avenue, New York. This circular is illustrated with two cuts showing the general layout of the belt and the central discharging point where the packages are received prior to their being placed in the delivery wagons. There are three conveyors 30 ins. in width, 71, 91, 191 ft. in length, respectively. There is one large flat belt 36 ins. wide and 75 ft. long guarded by skirt-boards designed for carrying unwrapped packages. The belts are driven by electric motors through worm reduction gears, and are entirely noiseless in their operation.

EFFICIENCY OF STEAM LOCOMOTIVES.—A publication, designated as Record No. 60, recently issued by the Baldwin Locomotive Works, partakes more of the nature of a discussion in detail of an engineering subject than of a "write-up" of a company's product. The publication contains a paper read before the Pacific Coast Railway Club by Mr. W. P. Evans on the actual efficiency of a modern steam locomotive compared with that of the lighter locomotive of twenty years ago. The paper gives much valuable information concerning the first cost, the interest on the investment, depreciation in value, the cost of fuel consumed, the cost of supplies used, the hauling capacity, the cost per ton-mile, the reliability of service and the time lost in shop repairs.

ALTERNATING AND DIRECT-CURRENT FANS.—A well-prepared publication of the Emerson Electric Manufacturing Company, St. Louis, Mo., designated as catalogue No. 4470, gives an adequate description of Trojan fans for alternating current. The motors operate on the induction principle without brushes or commutator or any small wearing parts that are liable to give trouble. The fans are designed for either ceiling or desk use, the latter type being arranged for converting into a wall fan when so desired. Catalogue No. 4490 of the same company is devoted to Emerson direct-current fans of the convertible wall and desk type. The details of Emerson fans for alternating current and the numerous uses to which they may be put are treated quite fully in catalogue No. 4460.

FAN MOTORS.—In preparing its 1907 catalogue of fan motors, the General Electric Company gave due consideration to the fact that the users of electric fans in general appreciate a thing of beauty, the result being that the catalogue will be given a place upon the reading tables in the homes of the users where the ordinary technical trade publication would receive no welcome whatsoever. As a work of art, the catalogue reflects much credit upon the persons engaged in its preparation. It is worthy of note in this connection that the business part of the catalogue has not been sacrificed in order to obtain beauty; the beauty is intended merely to insure that the catalogue will attract and hold the attention of the users of electric fans. Brief descriptions of alternating and direct-current fan motors for desk, wall and ceiling use are presented in a convincing manner without the use of technical terms.

INCANDESCENT LAMPS.—The Buckeye Electric Company, Cleveland, Ohio, has issued some interesting literature relating to high-efficiency incandescent lamps. Bulletin No. 3 treats of the graphitized-filament 50-watt lamp, while Bulletin No. 4 deals with the same type of lamp for from 100 to 250 watts. These lamps are stated to have a specific consumption of 2.5 watts per candle-power, as compared with 3.1 w. p. c. for the ordinary carbon-filament lamp. Bulletin No. 5 is devoted to the tantalum lamp having a specific consumption of 2.05 w. p. c. It is shown that using 20-cp lamps for comparison, with the ordinary carbon lamps costing 16 cents and having a life of 520 hours, the graphitized-filament lamp costing 20 cents and having a life of 560 hours, and the tantalum lamp costing 54 cents and having a life of 600 hours, the carbon lamp is the cheapest for energy costing less than 1.6 cents per kw-hour; the graphitized-filament lamp is cheapest for energy costing between 1.8 cents and 6.0 cents, while the tantalum lamp is cheapest when the energy costs more than 6.5 cents per kw-hour.

Business Notes.

FOOTE, PIERSON & CO., electrical manufacturers, have moved to 160-162 Duane Street, New York.

THE H. C. K. COMPANY has moved to 30 Greenwich Avenue, New York, which is rapidly becoming a center of manufacturing activity.

GOULD STORAGE BATTERY COMPANY, 1 West Thirty-Fourth Street, New York City, will move on June 1 to new offices at 341-347 Fifth Avenue, corner of Thirty-Fourth Street.

CATALOGUES AND PRICES on festive (Fiesta) decorative specialties and electric fountains for Mexico are wanted by Mr. E. V. Lawten, superintendent Potosina Electric Company, San Luis Potosi, Mexico.

THE WALLACE-LINDEMUTH COMPANY, a California corporation, is preparing to establish a plant in Fort Wayne, Ind., to manufacture steam, electric and gasoline hoisting machinery and general electrical supplies.

THE WILSON-CLARK COMPANY has opened a new electrical supply business at 204 South Twelfth Street, Omaha, Neb. Mr. Wilson was connected with the Burlington Railroad for some time, and for two years with the Omaha Traction Company.

CATALOGUES AND PRICES.—Anthorpe Wright Electrical Goods Purchasing Company, 105 Reade Street, New York City, wishes to receive catalogues, latest prices, etc. He proposes to act as purchasing agent, serving in this capacity for one central station in each town.

W. S. BARSTOW & CO., INC., engineers, have removed their offices to 50 Pine Street, in order to secure the much larger facilities demanded by their growing business. They maintain offices also at Portland, Ore., in the Failing Building, and at Montreal in the Bank of Ottawa Building.

MR. WALTER GERHARDI, Ludenscheid, Westphalia, Germany, is desirous of obtaining catalogues, circulars, booklets, reference lists, etc., direct from the makers of all classes of special and automatic machinery for the manufacture of electrical articles of any kind, including the allied industries.

THE ELECTRIC CABLE COMPANY will build an extensive addition to its plant at Bridgeport, Conn. The new building will be constructed of concrete and brick, and will embody the most improved forms of fireproof construction and equipment. The addition will be devoted exclusively to the production of weatherproof wires and cables.

M. I. T.—A large American superheater has been purchased for the mechanical department of the Massachusetts Institute of Technology, and the apparatus is probably the largest ever installed in a technical school in this country. It has a capacity equal to superheating 10,000 lbs. of steam per hour at 250 lbs. 250 degrees Fahrenheit. Shelby drawn tubes will be applied in the lower passages. It will be used primarily in connection with a 500-kw turbine set.

THE ENGINEERING OF LIGHT & ILLUMINATING COMPANY, of 25 Broad Street, New York, has retired from business and assigned all unfinished engineering work in hand to the Bureau of Illuminating Engineering, 437 Fifth Avenue, New York, which has facilities for undertaking all problems in lighting, embracing investigations, specifications and consultations for architects, public utilities companies and municipalities.

The C. I. F. COMPANY has removed its offices as export commission merchants to 32 Broadway, New York City. It claims to be the only company in the world having plans and methods for quoting c. i. f. prices on complete catalogues to all ports of the world. Its special effort is directed to selling mill and factory equipment, including building equipments and accessories, power generators, power transmission machinery and apparatus, stock handling devices, engineering and designing apparatus, metal and wood working machinery, mill supplies and allied lines. Mr. A. M. Fisher is president.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 30, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

851,654. FOUR WAY SNAP SWITCH; Nathan W. Crandall, Hartford, Conn. App. filed July 27, 1906. A snap switch of the type having an oscillating spindle carrying two pairs of switch arms, a rocking lever moved by a pair of push buttons and a spring and detent for imparting an abrupt movement to the spindle into a plurality of positions.

851,655. ELECTRIC HORN; Henry Csanyi, Orange, N. J. App. filed June 28, 1906. A diaphragm is contained in a chamber at the base of the horn and has an armature thereon which is vibrated by an electromagnet.

851,658. REACTANCE COIL; C. Le G. Fortescue, Wilkinsburg, Pa. App. filed March 23, 1906. The coil has a generally triangular frame sectionally built up of laminations and held together by bolts and clamping brackets. The coils are symmetrically placed on this frame on separate cores.

851,662. CONTROLLING APPARATUS FOR ELECTRIC MOTORS; Ray P. Jackson, Wilkinsburg, Pa. App. filed March 17, 1905. Diagram of connections for the controller of an alternating current motor having a safety device for preventing the transmission of current to the windings after the supply has once been cut off.

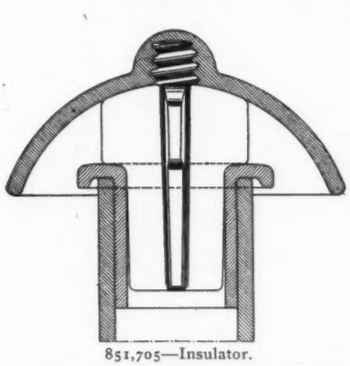
851,663. ELECTROMAGNET; Ray P. Jackson, Wilkinsburg, Pa. App. filed April 3, 1905. An alternating current magnet designed to reduce the vibration between the magnet and its core to a minimum. The magnet has two solenoid armatures which act together with a scissorslike movement.

851,664. SYSTEM OF CONTROL; Ray P. Jackson, Wilkinsburg, Pa. App. filed April 13, 1905. Provides means for causing two or more voltage regulators to operate synchronously so that all the regulators will supply approximately the same voltage to the motors or other translating devices.

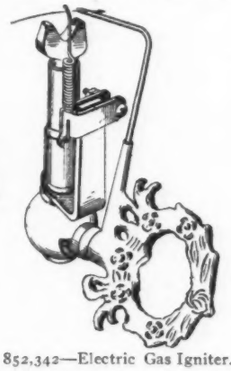
851,665. VOLTAGE ADJUSTMENT MEANS; Ray P. Jackson, Wilkinsburg, Pa. App. filed July 9, 1906. Relates to modifications of the above.

851,666. VOLTAGE REGULATOR; Ray P. Jackson, Wilkinsburg, Pa. App. filed July 9, 1906. Additional modifications.

851,667. RESISTANCE TERMINAL; Henry D. James, Pittsburg, Pa. App. filed May 16, 1906. A metallic sheet metal part or stamping having a lateral projection at one end in the plane of its body portion and adapted to be attached to the resistance wire, the other end having a lateral projection perpendicular to the plane of the body portion and adapted to be attached to the binding screw or terminal.



851,705—Insulator.



852,342—Electric Gas Igniter.

851,671. SUPPORTING DEVICE FOR ELECTRIC CONDUCTORS; Budd J. Jones, Chicago, Ill. App. filed March 14, 1904. Renewed Nov. 12, 1904. Relates to hangers for trolley wires of the type having a single line of poles between the tracks. Is formed of specially bent angle irons which cooperate with a form of porcelain insulator.

851,682. ELECTRICALLY CONTROLLED ELEVATOR; Wm. D. Lutz, Allendale, N. J. App. filed June 22, 1905. Control system for electric elevators of the type adapted to be installed in private dwellings and having push buttons at the various floors by which the movements of the car are automatically controlled.

851,685. VACUUM TUBE LIGHTING; Daniel M. Moore, Newark, N. J. App. filed Nov. 16, 1905. Details of Moore electric light system. The lighting is obtained from a plurality of vacuum tubes placed end to end in danger proof boxes or casings, and having the electrodes of the contiguous ends electrically united to form a practically continuous tubing of light.

851,690. ELECTRIC SWITCH MECHANISM; F. C. Newell, Wilkinsburg, Pa. App. filed Aug. 11, 1902. Relates to electric switch mechanism designed to produce efficient opening and closing of main circuit terminals by means of a pilot or controlling switch. Is designed to close the circuit with certainty and quickness and break the circuit so as to overcome arcing.

851,691. ELECTRIC SWITCH MECHANISM; F. C. Newell, Wilkinsburg, Pa. App. filed Aug. 2, 1905. A controlling switch for air compressor systems of the type where the circuit of a motor is broken when the pressure attains a predetermined value. Has two movable switch arms governed by separate magnets so that they repel one another to break the circuit or attract one another to complete it.

851,692. AUTOMATIC BLOCK SIGNAL SYSTEM; F. P. J. Patenall and G. H. Dryden, Baltimore, Md. App. filed Dec. 4, 1906. Block signal system of the type having track rails energized by direct currents of low voltage and circuits including relays for the operation of the signals and adapted to be short circuited by the wheel axles of the trains.

851,695. ROTARY CONVERTER SYSTEM; W. S. Ruff, New York, N. Y. App. filed Jan. 30, 1905. Relates to systems of electrical distribution embodying rotary converters, and it has for its object to provide means for controlling the speed of such machines. The ordinary circuit breaker is eliminated, and means substituted therefor which controls the speed without putting the converter out of service.

851,704. METHOD OF SPEED REGULATION; N. W. Storer, Pittsburg, Pa. App. filed July 24, 1905. Relates to a system of control of electric vehicles having a plurality of motors by which efficient operation is secured at the low as well as at the high speeds.

851,705. INSULATOR; Hugo Stotz, Mannheim, Germany. App. filed Dec. 10, 1906. Designed to introduce wires into a building through a tubular support. Has a shoulder piece of star-shaped section with a drip-bell thereon, all formed integrally of porcelain.

851,709. POTENTIAL REGULATOR; W. H. Thompson, Wilkinsburg, Pa. App. filed June 26, 1906. A system including a movable coil transformer and a fluid pressure actuating cylinder therefor, and means for controlling the flow of air to the cylinder determined by the circuit conditions.

851,726. SERVICE ENTRANCE BOX; F. B. Adam, St. Louis, Mo. App. filed June 25, 1906. A casting designed to be built into the wall of the building in place of an ordinary brick. Has an overhanging ledge through which the wires enter and which serves to drain the water therefrom.

851,738. METHOD OF AND APPARATUS FOR TRANSFORMING SINGLE OR POLYPHASE INTO CONTINUOUS CURRENT; Georges Faget, Paris, France. App. filed Oct. 22, 1904. The method of transforming single or polyphase current into a continuous current which consists in distributing the polyphase currents in the primary circuit so as to generate distinct rotary fields in separate parts of space, to produce separate inductive effects from different parts of the secondary and rectifying the currents so generated in the secondary.

851,739. PROTECTION OF SECONDARY CIRCUITS; Samuel Ferguson, Schenectady, N. Y. App. filed Sept. 9, 1904. An automatic circuit closing device comprising two mercury conductors separated by a thin insulating member, and means for connecting said conductors to an electrical current.

851,743. VARIABLE VOLTAGE TRANSFORMER; E. F. Gehrkens, Schenectady, N. Y. App. filed July 9, 1906. Provides a transformer in which the secondary voltage may be reduced absolutely to zero if required. Has a third coil in inductive relation to the primary and connected in series with the secondary. The transformer core has movable portions so as to change the flux relations between the different coils.

851,747. PROCESS OF DRYING ELECTRIC CABLES; W. B. Hale, Mexico, Mexico. App. filed March 12, 1906. The process of drying cables which consists in maintaining a flow of electric current through the insulating material of the cable, of sufficient strength to electrolyze the moisture therein.

851,751. JUMP SPARK INDICATOR; O. C. Hoffman, Buffalo, N. Y. App. filed March 21, 1905. The fuse is provided with a shunt circuit having a spark gap associated with means to produce a discoloration in case a spark passes. There can be no spark at this gap except when the fuse is blown so that an indication is thereby provided of this fact.

851,762. TELEPHONE SWITCH-HOOK; Alfred Larsson, Buffalo, N. Y. App. filed May 22, 1906. Has a bridge carrying a set of contacts, said bridge being provided with upwardly projecting lugs whereby said bridge may be tilted.

851,762. CONTROLLING MEANS FOR AUTOMOBILES; Hermann Lemp, Lynn, Mass. App. filed June 14, 1905. Relates to the control of automobiles of the type having a generator constantly driven from gas engine carried by the vehicle. Has means for closing the throttle of the engine in case of failure of the current.

851,775. ELECTRIC ATTACHMENT FOR TANKS; H. E. Reeve, Brooklyn, N. Y. App. filed Feb. 3, 1906. A float is mounted between a pair of swinging arms on a horizontal axis and having a special lever connection with a switch in an enclosed chamber, by which the switch arm has an abrupt movement.

851,776. AUTOMATIC TRAIN BLOCKING SYSTEM; Chas. E. Roehl, Brooklyn, N. Y. App. filed Dec. 16, 1903. Details of construction of the trolley rails and insulators of a block system designed to prevent collisions by shutting off the power and applying the brakes automatically on the engine.

851,786. CONTROLLING SWITCH FOR TRANSFORMERS; M. O. Troy, Schenectady, N. Y. App. filed June 22, 1906. Switching devices for transformers, particularly for step-down transformers, inserted between high voltage supply circuits and low voltage translating devices such as motors. Provides an automatic switch in the primary circuit and controlled by the switch in the secondary circuit of the transformer.

851,792. TELEPHONE EXCHANGE SYSTEM; Johan A. Aven, Stockholm, Sweden. App. filed Nov. 1, 1904. Details of circuits of a multiple exchange system having a special means for testing the busy circuits.

851,793. BRUSH HOLDER; R. E. Barker, Lynn, Mass. App. filed Nov. 13, 1903. Mechanical features of construction of the brush holders of a small motor having a wholly enclosed commutator. The brushes are spring impelled in metallic tubes contained in insulating brushings in the frame of the motor.

851,795. RELAY; E. F. Bliss, Schenectady, N. Y. App. filed Aug. 17, 1906. Track relays for block signal systems designed to make the number of turns in the track winding adjustable in a simple manner. It is desirable that all the track relays in a block signal system be identical in construction except that the number of turns should vary for different lengths of block. Provision is made for securing this result.

851,797. CLUTCH MECHANISM; Tito Livio Carbone, Berlin, Germany. App. filed Nov. 25, 1905. An arc lamp regulator having one electrode suspended by a chain passing over a brake wheel. The brake is applied by lever connections from the armatures of a pair of solenoid magnets.

851,799. ELECTRIC TRACTION SYSTEM; A. Churchward, Schenectady, N. Y. App. filed June 1, 1906. Relates to trackless trolley systems in which the car runs a part of the time from an overhead trolley and thereafter runs for short distances on branch roads from storage batteries. Covers features of the control system.

851,803. TELEPHONE TRUNKING SYSTEM; W. W. Dean, Chicago, Ill. App. filed July 14, 1902. Complete circuits of telephone exchange system having A boards and B boards.

851,804. CONTROLLER FOR ELECTRIC MOTORS; C. A. Dresser, Chicago, Ill. App. filed June 19, 1902. A device for controlling a plurality of motors comprising resistance contacts for each motor and a single solenoid having connections for simultaneously operating the resistance devices of each motor.

851,808. AUTOMATIC SWITCH FOR ELECTRIC CIRCUITS; C. H. Hill, Schenectady, N. Y. App. filed Oct. 22, 1904. Relates to automatic switches and particularly applicable to the control of motor generator sets for charging a storage battery. Has means operated by the diminution of the current flow when the battery is fully charged for opening the circuit of the driving motor.

851,811. AUTOMATIC MOTOR STARTER; C. D. Knight, Schenectady, N. Y. App. filed May 25, 1906. A control system for a pump motor adapted to be operated from a distant point, such, for example, as the float in a tank filled by the pump. Has separate pilot circuits respectively controlling a power and a locking magnet.

851,823. SYSTEM OF MOTOR CONTROL; W. L. Merrill, Schenectady, N. Y. App. filed July 21, 1906. System for controlling the motors which operate bulkheads from a distant point. Is designed to reduce the size of the wire required in the system.

851,828. ALTERNATING-CURRENT MACHINERY; A. S. McAllister, New York, N. Y. App. filed April 2, 1906. The combination with an alternating-current machine, having a rotor provided with a commutator composed of alternate live and dead segments, of three separately insulated brush units at each active point of commutation and a reactive connection between any two of said brush units; substantially as described.

851,829. ELECTRICALLY CONTROLLED ELEVATOR; C. and F. C. Naujoks, San Francisco, Cal. App. filed April 16, 1906. An elevator designed for private dwellings in which the car is controlled by a plurality of buttons on the floors and on the car so that a special operator is not required.

851,837. GATHERING LOCOMOTIVE; J. M. Roan, Columbus, Ohio. App. filed Dec. 4, 1905. A mining locomotive of the type having a trolley and having a reel for electric cable. Has spring means for rewinding the reel and clutch connections from the main motor for connecting it to the reel without stopping the motor.

851,838. CIRCUIT FOR COIN COLLECTORS; J. G. Roberts, Chicago, Ill. App. filed Feb. 13, 1906. A coin collecting telephone system having means for preventing an accidental disposal of a coin deposited by a subscriber in his coin receiving apparatus, and at the same time leaving the final disposition of the coin under the control of the operator at the central office without aid from the subscriber.

851,856. MEANS FOR NULLIFYING INDUCTIVE INTERFERENCE BETWEEN PARALLEL CIRCUITS; Edward Blakeney, Ossining, N. Y. App. filed Jan. 7, 1907. The combination with adjacent signaling lines, each having a receiving instrument, of a winding located upon a receiving instrument, and being connected only with a companion line.

851,890. METHOD OF STARTING ALTERNATING CURRENT MOTORS; W. A. Layman, St. Louis, Mo. App. filed Aug. 6, 1906. The method of operating an alternating-current motor, which consists in starting said motor on a voltage below normal operating voltage, and raising said voltage before normal running speed under load is attained.

851,891. METHOD OF ELECTRICALLY BRAKING ALTERNATING CURRENT MOTORS; Waldo A. Layman, St. Louis, Mo. App. filed Aug. 6, 1906. The method of breaking an alternating current motor circuit, which consists, after the main driving current has been cut off from the motor, in varying an auxiliary current with the speed of the motor, and applying said auxiliary current to oppose the rotation of the motor.

851,922. METHOD OF EXTRACTING POTASH FROM FELDSPATHIC OR OTHER POTASH-BEARING ROCK; . App. filed Jan. 14, 1907. A method of extracting potash soda and other alkaline bases from rocks and materials containing the alkaline metals, which consists in electrolyzing the material in the anode chamber of a diaphragm cell in an aqueous electrolyte containing hydrofluoric acid.

851,933. ELECTRIC ELEVATOR CONTROLLER; H. F. Gurney, Jersey City, N. J. App. filed April 30, 1906. Details of control system for starting, stopping and reversing an electric motor used in connection with an elevator system.

851,934. ELECTRIC ELEVATOR; H. F. Gurney, Jersey City, N. J. App. filed April 30, 1906. Relates to modifications of the above.

851,948. TELEPHONE SYSTEM; J. W. Lattig and C. L. Goodrum, Philadelphia, Pa. App. filed April 4, 1903. Cord circuits of multiple exchange telephone switchboard having various detail features.

851,961. ELECTRIC FURNACE; H. N. Potter, New Rochelle, N. Y. App. filed July 23, 1903. In a furnace means for heating the furnace body and means for superposing in the furnace the heat of an electric arc or conducting gap.

851,975. INCANDESCENT LAMP SUPPORT; Edmond Beaudette, Montreal, Que., Canada. A lamp support of the type having a spring reel enclosed in a casing and from which depends a flexible electric cord. The circuit is completed through a pair of brushes and commutator rings.

851,979. ELECTROMAGNETIC SEPARATOR; Wm. Blackmore, London, England. App. filed Sept. 19, 1904. Relates to the separation of ores of more or less magnetic permeability by passing the ores crushed and in a wet state through a strong magnetic field. Has a revolving conical table whose rim passes through opposing pole pieces of an electromagnet so as to retard magnetic particles and separate them from the non-magnetic ones.

851,994. TELEPHONE-SWITCH; Timothy S. Mount, Thome, Tex. App. filed Sept. 19, 1903. In a telephone box provided with party line terminals and suitable connections, mechanism for short-circuiting one end of the said party line connections and for completing a circuit with the other end of said party line connections at the will of the operator.

851,997. FUSE HOLDER; J. C. Ralls, Los Angeles, Cal. App. filed Aug. 6, 1904. Details of construction of an out-door fuse for telephone connections. Has a central insulating body with metallic caps threaded thereto at each end in such a way as to make an electric connection with the fuse wire by such engagement.

852,004. AUTOMATIC TELEPHONE SWITCH SYSTEM; John Wicks and Donald D. McKay, Riverside, Cal. App. filed Aug. 30, 1905. A selecting system for party line telephone systems, including wipers connecting a generating means to either of two line wires of the body line.

852,026. PROTECTION OF ELECTRICAL SYSTEMS FROM LIGHTNING AND OTHER STATIC DISTURBANCES; R. D. Mershon, New York, N. Y. App. filed May 8, 1905. System for protecting electric apparatus from destructive effects of lightning. Has a line conductor a portion of which is of diminished electrostatic capacity and one or more arrester devices connected to the conductor and to ground.

852,027. ALTERNATING-CURRENT MACHINES ON SINGLE CIRCUITS; R. D. Mershon, New York, N. Y. App. filed Sept. 29, 1904. The combination with the primary element of an alternating-current machine, of a reactance and a capacity connected to the primary element, and connections from the primary element to a single phase circuit, said circuit connections being intermediate to the connections of the reactance and capacity, as set forth.

852,028. ELECTRIC MOTOR AND OTHER APPARATUS IN WHICH THERE IS MAGNETIC FLUX; R. D. Mershon, New York, N. Y. App. filed March 14, 1904. In an electrical apparatus, the combination with an annular element of polygonal cross section having a ring winding or windings laid in slots therein, of an annular element having a plurality of faces adjacent the same number of surfaces on the first element, as set forth.

852,037. SAFETY FUSE TERMINAL; J. Sachs, Hartford, Conn. App. filed March 9, 1906. A fiber tube has caps of sheet metal which are embossed or perforated in such a way as to engage sheet metal brackets forming the fuse terminals. The fuse wires engage holes in the caps.

852,092. ELECTRICALLY CONTROLLED SEMAPHORE SIGNAL; H. M. Abernethy, Cleveland, Ohio. App. filed Dec. 7, 1905. Semaphore signal of the type controlled by reduction gear connections from an electric motor which is started into operation and clutched to the gear train. Clutch is released by magnet to allow the semaphore to fall to danger.

852,093. RAILWAY SEMAPHORE SIGNAL; H. M. Abernethy, Cleveland, Ohio. App. filed Dec. 7, 1905. Relates to modifications of the above.

852,094. RAILWAY SEMAPHORE SIGNAL; H. M. Abernethy, Cleveland, Ohio. App. filed Dec. 7, 1905. Additional modifications of the above.

852,133. ELECTRO-THERAPEUTICAL INSTRUMENT; J. W. Moliere, Oakland, Cal. App. filed July 18, 1906. Details of construction of a static machine having a specially formed generating disk with radially disposed pockets for impelling air through the machine whereby it will be ozonized.

852,163. MASSAGE IMPLEMENT; L. B. Buchanan, Woburn, Mass. App. filed Oct. 27, 1906. A hand device having a plurality of metallic rollers which establish an electric circuit between them from a small shocking coil contained in the handle.

852,186. ELECTRICAL CURRENT INTERRUPTER; F. W. Lord and F. W. Erickson, New York, N. Y. App. filed Jan. 28, 1907. Means for grounding electric circuits in case of a lightning discharge or abnormally heavy current. Has a series of rotatable insulated spark-gap electrodes separated from each other and arranged in a circle cencentric with a ground electrode rotated by an electric motor.

852,188. DRY BATTERY; C. D. Manville, Pittsburg, Pa. App. filed Nov. 20, 1906. In order to avoid loosening the connections of a dry battery in an automobile by the jar, patentee has the battery spring supported in a special guiding frame or casing.

852,193. ELECTRIC EXERCISING APPARATUS; A. B. McMillan, Brooklyn, N. Y. App. filed April 4, 1906. The straps or cords of an exercising machine are made with metallic wire to establish the circuit from a small generator driven by the movement of one of the cords.

852,226. BURGLAR ALARM RELAY DROP; D. D. Friedman, New York, N. Y. App. filed May 17, 1906. Provides means for locking the armature of a burglar alarm relay, in case the circuit of the magnet is only temporarily broken.

852,265. HEADLIGHT; M. E. Fuld, Baltimore, Md. App. filed Jan. 30, 1906. A specially formed bracket designed to be attached to the forehead, and worn by oculists, etc., in making examinations. The bracket adjustably supports a small electric lantern.

852,279. ELECTRIC DOOR OPENER; Jos. Loch, Brooklyn, N. Y. App. filed April 17, 1906. A magnetic door latch having a lever engaged by the magnet armature and a strike having a slide pivoted thereto and straddling the fulcrum of the lever.

852,338. ELECTRIC STOVE; A. L. Marsh, Lake Bluff, Ill. App. filed Feb. 18, 1907. The stove has a block of refractory material provided on its outer side with an uncovered groove, and an electric resistance exposed to the atmosphere in said groove, and connecting with a supply of current.

852,342. ELECTRIC GAS IGNITER; F. C. Nickel, J. E. Martin and Charles Edmund Blackburn, Jacksonville, Ill. App. filed Feb. 6, 1906. Has a gas lighting arm projecting from the usual turn cock.

852,347. PROCESS OF PRODUCING LOW-CARBON FERRO ALLOYS; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. The process of producing ferro-alloys, which consists in producing ferrosilicon by smelting a suitable charge, removing the molten silicid from the smelting zone and bringing it in contact with a compound of a metal reducible by silicon and alloyable with iron, as set forth.

852,381. WIRELESS-TELEGRAPH RECEIVING SYSTEM; Lee De Forest, New York, N. Y. App. filed Dec. 4, 1905. In a wireless telegraph receiving system, the combination with a loop antenna and a tuned receiving circuit, of a transformer having two primary windings securely connected in said loop antenna and a secondary winding inductively related to said primary windings and forming a part of said tuned receiving circuit.

852,386. HAND OPERATED ELECTRIC CIRCUIT CONTROLLER; Ray P. Jackson, Wilkinsburg, Pa. App. filed Dec. 18, 1905. Provides means for automatically returning a controller drum to a predetermined position, and which shall exert a substantially constant returning force whatever the angle or direction through which the drum is moved.

852,395. CIRCUIT CONNECTOR; C. F. Patterson, New York. App. filed June 29, 1906. A circuit controller adapted to be operated by a key in the manner of a Yale lock. Has the usual spring impelled tumbler pins.

852,405. RAILWAY SIGNALING APPARATUS; E. R. Wolcott, Golden, Colo. App. filed Dec. 27, 1904. Relates to railway signaling apparatus in which electric impulses are transmitted between stations and trains by magnetic induction. The car has a transmission circuit normally open when the train is in motion, and means for automatically and permanently closing the circuit when the strain stops.